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ABSTRACT

This report presents the results of a study, based on 500 responses to a survey mailed to a structured sample of school administrators, on the problems and solutions of developing thinking and reasoning skills in the schools. Provided are analyses of the issue, examples of successful practices, and advice from school administrators and researchers. Eleven chapters describe the following subjects: (1) an overview: the millenarian goal; (2) the surge of interest and effort; (3) the information society; (4) pioneers and practitioners of thinking instruction; (5) background for action; (6) what cognitive scientists know and report about thinking, its processes, and skills; (7) programs; (8) success stories; (9) impact on curriculum; (10) working with the board; and (11) assessing results of thinking instruction. (SI)

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AASA CRITICAL ISSUES REPORTS

TEACHING THINKING
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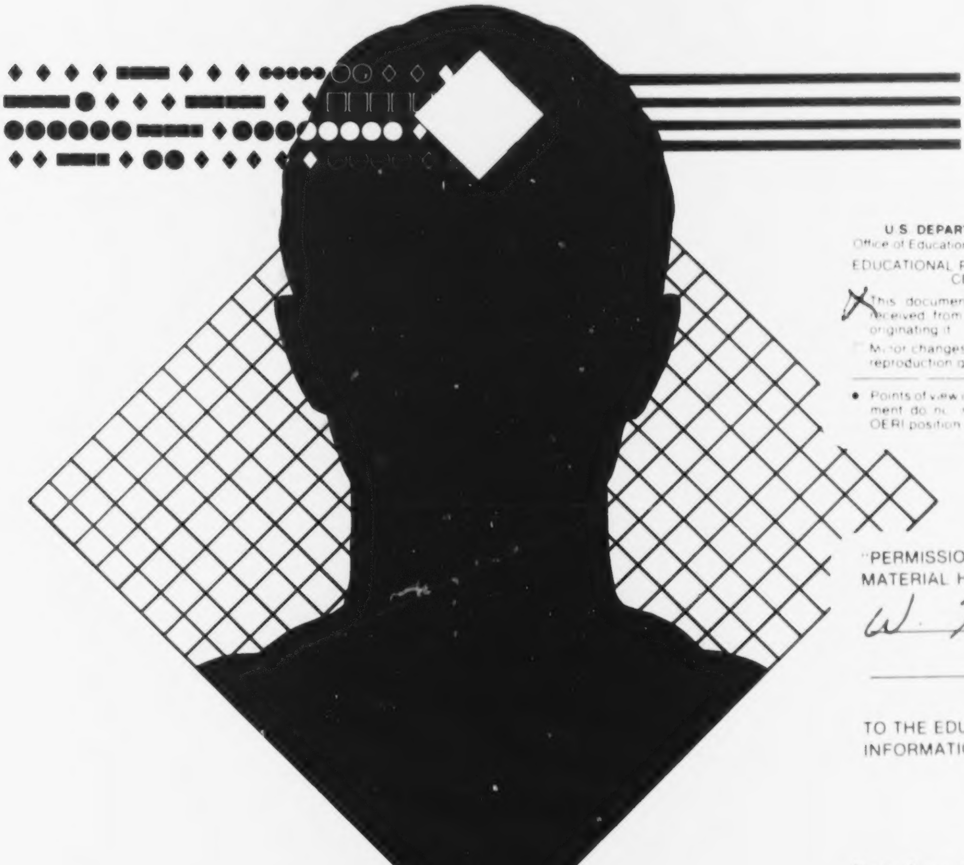
Problems and Solutions



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American Association of
School Administrators

AASA Critical Issues Report

TEACHING THINKING

AND REASONING SKILLS

Problems and Solutions

By Robert A. Pauker, Ed.D.

Developed under the editorial direction of
Ben Brodinsky
Editor, Critical Issues Reports

The AASA Critical Issues Series

Even those who avoid the word "revolution" when applied to aspects of American education admit something close to that is happening in the teaching of thinking skills in elementary and secondary schools. Certainly, momentous changes in research and application of that research to classroom situations are taking place. The movement in thinking has been called a groundswell of the 1980s. Teaching thinking and reasoning skills was one of the top concerns identified in an issues study recently conducted by our association.

That is the reason the American Association of School Administrators decided to study the problems and solutions of developing thinking and reasoning skills in the schools. As has been the case with similar Critical Issues Reports, *Teaching Thinking and Reasoning Skills* provides analyses of issues, examples of successful practices and sound advice from school administrators and researchers.

Our thanks to the school administrators who responded to our survey on this important issue. Our appreciation also goes to the scores of leaders in organizations, colleges and universities, and school districts who have provided information through interviews, correspondence, and telephone conversations.

Teaching Thinking and Reasoning Skills is the 20th report in the AASA Critical Issues Series. It was written by Robert A. Pauker, Ed.D., of West Hartford, Connecticut, and developed under the editorial direction of Ben Brodinsky, editor of the series.

RICHARD D. MILLER
Executive Director
AASA

GARY MARX
Associate Executive Director, AASA
Office of Communications

Editor, AASA Critical Issues Reports: Ben Brodinsky
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PREFACE

The story of American schools is, in part, the story of innovations proposed and innovations rejected; of reforms touted as panaceas; and of these same reforms partly ingested and mostly rejected.

A long look at American school practices during the past half century shows a mixed record of some successes and more failures in efforts to improve what and how students learn and how administrators have supported the educational process.

Take some random examples. Junior high and middle schools, teacher aides, advance placement—once controversial innovations—have proved durable. But where, oh where, asks the disillusioned school observer, are the open classroom, new math, new science, mastery learning, and programmed instruction?

And what about today's renewed efforts to introduce thinking skills into the daily lessons of all subjects? How lasting will be our commitment to develop student skills in thinking and reasoning? Will such programs endure?

Predictions may be premature.

We are in the early stages of an unfolding movement for the development of thinking and reasoning skills in the nation's schools. But movement it *is*—and rapidly unfolding—and it has brought with it the classic phenomena that accompany any major ventures for educational change and reform. Here are some of these phenomena:

Research: Like any idea seeking legitimacy in education, the thinking skills movement claims a research base. Some of this research is scholarly and thorough; some only claiming to be so; some goes back half a century; some is newly-sprung. Researchers in colleges, universities, laboratories (privately- and publicly-supported), and in large school districts are working out the psychological and pedagogical bases for thinking skills programs. New products continually emerge from these efforts.

Publication: With research comes publication. The number of books, articles, and monographs is growing year to year. The Education Index for the past three years shows a doubling of entries on thinking compared to the three year period before that. Educational periodicals have opened their pages to articles explaining, defending, analyzing, and extolling a variety of approaches to teaching thinking skills.

Product dissemination: Producers of thinking skills programs have not hesitated to place their products for sale. The rush to the marketplace by program developers has made many school administrators wary of claims for programs available for purchase. More significantly, commercially-produced thinking skills packages, carrying relatively high price tags, raise a serious question for school districts: should we buy or develop our own?

Trial and test: When put to the test, some commercially-produced programs fail to meet the unique needs of school districts—district after district report abandonment of plans to maintain thinking instruction with acquired materials. Districts venturing to develop programs to meet their special needs usually proceed slowly—testing, revising, reconstructing approaches and materials. The future success of the thinking movement lies as much with these venturing school districts as with scientists in psychological workshops.

Debate and discussion: One indication that the thinking movement is vigorous and strong is the degree of critical debate and discussion it can absorb. In these early stages of the movement's life, partisans and opponents are involved in arguments and counterarguments; make claims and counterclaims; indulge in partisanship and overenthusiasm; and expound on the weaknesses and strength of thinking programs.

The movement has also confronted a growing opposition from those who say "it can't be done," and those who proclaim "we shouldn't do it." Fundamentalist groups and far-right advocates oppose instruction leading to inquiry, open-ended classroom discussion, independent investigation, or decision-making—to name only four components of thinking skills.

Arguments abound that (1) as research and scholarly publication continue; (2) as products are tested in the marketplace and in school systems; and (3) as the crossfire of debate and discussion eliminate questionable thinking skills programs and practices, the thinking movement will grow stronger.

These same arguments hold that, indeed, there is something different about this movement which may ensure its placement in the schools.

This "something different" stems from the belief that thinking is the basic of the basics; that it is requisite for mastery of all subject-matter in the curriculum; and that it is the essential skill for success in the 21st Century, when, *not* the acquisition of facts but their analysis and management, will be the key to national and personal survival and success.

Thinking students are needed now and will be needed for generations to come.

The testing programs to which students of all ages have been subjected during the past decade reveal clear-cut evidence that American students are gradually getting a grasp on basic facts and fundamental skills. But they are woefully lacking in "higher order intellectual skills" needed for organizing thought, generalizing, reaching independent conclusions, selecting the relevant from the irrelevant, and creating new ideas.

One such item (of many) came to light at the end of 1986, when the National Assessment of Educational Progress (NAEP) released a study showing that only 20 percent of students tested could produce an acceptable piece of writing "because of a pervasive lack of emphasis on higher order skills throughout the school curriculum."

Similar conclusions have been reached in testing programs conducted by states and school systems: the majority of students usually master the minimum essentials of mathematics, science, social studies, language arts, but do not rise to higher levels of achievement because classrooms and teachers do not provide adequate thinking and reasoning experiences.

To provide such experiences for students of all ages and in all courses of study is the persistent challenge before school districts. As the pages of this report show, chapter by chapter, it is a challenge requiring strong commitment and long-term effort. We are not dealing here with temporary problems or transitory solutions. How the nation's school administrators confront these problems and lay the basis for lasting solutions is the story of this report.

In Search of the Millenarian Goal—the Thinking Student

Education's interest in developing thinking skills in students takes on new life—Causes behind the interest briefly listed—Role of the corporate community, social scientists, educational leaders—Three deep convictions of superintendents about thinking instruction—What else superintendents say and think about the challenge.

When, in 1933, John Dewey published his seminal work, *How We Think*, he provided testimony that the schools of the United States had a keen interest in the millenarian goal—how to help students become rational and reasoning individuals. During the decades before and after Dewey's work, interest in thinking instruction intermittently flared and faded.

A bright light flashed across the educational scene when Benjamin Bloom published in 1956 his *Taxonomy of Educational Objectives, Handbook 1: Cognitive Domain*. This work inspired some school districts to pursue the goal of teaching thinking, notably the 1956 start of the thinking skills project in Manitowoc, Wisconsin. (In Chapter 8 you will read what happened in Manitowoc consequently.)

In 1961, the Educational Policies Commission (now defunct) came out with its ringing statement that "the purpose which runs through . . . all other educational purposes . . . is the development of the ability to think. . . . This is the central purpose to which the school must be oriented," the Commission said in a document appropriately titled *The Central Purpose of American Education*.

Directly or indirectly, the Commission's report prompted a number of school districts toward new ventures in teaching thinking—among them Glen Ridge, New Jersey; Contra Costa County, California; Concord, Massachusetts; and Shaker Heights, Ohio.

While studies and reports calling for change and reform in education came and went, small pockets of teachers and curriculum workers continued to espouse the cause of critical thinking. During the 1960s, many faculties pursued "inquiry training" as a method for promoting thinking in social studies, English, mathematics, and science. Inquiry training covered a host of concepts, aims, and practices: fostering student curiosity, encouraging better questions from students, independent study, logical thinking, and better note-taking by students in class.

In 1963, John Marshall High School faculty members, in Richmond, Virginia, published a remarkable pamphlet for students called "Critical Thinking." Without benefit of research, the faculty committee outlined the nature of critical thinking in grammar, listening, spelling, writing, reading fiction and nonfiction, history, science, and mathematics. The authors adopted the device of contrasting "the Lazy Thinker versus the Critical Thinker." For example, in studying grammar, the pamphlet said, the Lazy Thinker memorizes rules; the Critical Thinker looks for reasons. In reading nonfiction, the Lazy Thinker accepts facts; the Critical Thinker weighs the evidence and disputes the conclusions.

But such instances of school concern were rare.

It took the work not only of John Dewey, but also Jean Piaget, Hilda Taba, Benjamin Bloom, and others to awaken the interest and restimulate the efforts of rank and file educators in thinking instruction. During the first half of the 1980s, the thinking movement permeated ever larger groups of teachers, curriculum workers, and school administrators. By 1986, we reached the point of a groundswell. (See Chapter 2, "A Surge of Interest.")

Reasons for the Momentum

Why has the thinking skills movement gained momentum?

One reason: the influence of the educational reports published during the first half of the 1980s. Some of these, such as *A Nation At Risk*, do not directly address the need for incorporating the thinking process into daily classroom experience. Nevertheless, the reports did express a concern about the preparedness of American youth to enter adult life with an ability to reason. The impact of these reports is discussed in Chapter 3.

A second reason for the current thrust of the thinking skills movement is the influence of corporate America on education, also discussed in Chapter 3. A decade earlier, corporate executives had made an impact on education through the management-by-objectives (MBO) approach. Beginning in the early 1980s, books dealing with the future of industry, such as *Megatrends* and *In Search of Excellence*, started to influence the ideas of educators on the need for teaching thinking skills.

Corporate literature of the early 1980s forecast a society in which the problem-solver, the decision-maker, and the creative thinker would have an advantage in the marketplace and on the career ladder. More important, corporate executives pointed out that industry and business will, more and more, require workers who can cope with information—analyze it, manage it, master it.

In the early 1980s, social scientists made the point that the adult of the future will face a series of drastic changes not only in the workplace, but also at home and in the community "because we shall be living in an information society."

Message to the Schools

The voices of educational reformers, corporate leaders, and social scientists sent a strong message to the nation's school districts. That message said: Teaching the traditional basic skills is essential—but that is not enough.

Listen to these words in support of this view:

> They can read, but can they comprehend all that they are reading? They can add and subtract, but can they understand when to add or subtract in a problem? They can make a verb agree with a noun, but can they write a one-page essay?

The speaker of these words was Connecticut's State Education Commissioner Gerald N. Tirozzi. All fourth-grade students in his state had taken "a mastery test," and the results, as Tirozzi studied them (January 1986), were sobering. Test data showed that the fourth-graders scored well on basic facts and literal understanding, but did poorly on questions that required broad understanding of concepts and application of concepts.

The Connecticut "mastery test" findings are part of a national revelation that American students—from fourth grade through high school—have in many instances returned to the basics, but that they are hardly within sight of a larger goal, ability to master high-level thinking skills.

From other sources come similar comments supporting Tirozzi's conclusion. Superintendent Richard Shelton, Waynesboro, Pennsylvania, summarizes these comments as follows: "Basic skills in this country have *not* been a failure, while our ability to help youngsters become critical thinkers *has*."

Did the basic skills emphasis of the late 1970s hurt student ability to think? "I don't have any evidence one way or the other," says Jerry Marcus, superintendent in White Plains, New York. "It seems to me that in the past 30 years, student analytical ability has not really changed. However, there has been a change in attitude, rather than in ability. The students of today seem to be more passive in tackling intellectual and analytical exercises. I attribute these attitudinal changes more to environmental factors than to curriculum," concludes Marcus.

One of the outcomes of the thinking skills movement is introspection among superintendents about citizenship. "You can't be a good citizen if you are mindless," states Peter Greer, of Portland, Maine, schools.

"Thinking skills are necessary to build and to maintain a democracy," says Roger LaRaus, a thinking skills innovator in the Evanston, Illinois, schools. "Our whole system of government depends upon people's ability to generate alternatives and to examine consequences," LaRause adds.

What Superintendents Say and Think

Superintendents hold three convictions about teaching thinking skills and they hold them in large numbers and with overwhelming intensity. These are that:

(1) Instruction in thinking and reasoning skills is important for students and the community

(2) It is feasible and practical for a district to install thinking skills instructional programs

(3) Teaching of thinking skills must not be done "in isolation," but must be incorporated into subject-matter offerings.

The first question of the AASA survey mailed to a structured sampling of the nation's school administrators asked: "Is instruction in thinking skills important?" Of 500 responses, some 89 percent answered, "Yes, very." About 10 percent answered "Probably important," and only a negligible number answered "Other subjects are more important."

A strong response also came to the question "Is it feasible and practical for a district to install thinking skills programs?" Some 65 percent answered, "Yes, very much so," and 33 percent answered, "Possibly." Negative responses were few.

In responding that it was feasible and practical for schools to introduce instruction in thinking skills, large numbers of superintendents added the caveats: "Thinking should be integrated into the

At three stages

What Administrators Are Doing About Thinking Skills Instruction

Questionnaires returned by some 500 school administrators for this report indicate they are at three different stages in introducing or maintaining thinking instruction in their school systems: (1) wait and see stage; (2) exploration stage; and (3) active stage.

Wait and see stage: In this category are respondents who report that they are doing very little, believing that classroom teachers should take responsibility for developing thinking skills. Also in this category are those who report: "We hope to do something in the near future. . . ." "We're thinking about it. . . ." "Waiting to see how the movement develops. . . ." "Plan to make thinking instruction a district goal sometime in the near future. . . ." Estimated percent: 80.

Exploration stage: Respondents in this category report that they are preparing themselves for future action—through reading, attending seminars, talking with other administrators, conferring with consultants in cognitive skills. Among comments: "We're encouraging teachers and staff members to study, experiment, and explore. . . ." "We're encouraging curriculum directors to develop thinking skills units. . . ." Estimated percent: 15.

Active stage: In this category are respondents who have already introduced a thinking skills program—some on a pilot basis, or in a limited number of school buildings or selected grades. Often this means that the district has acquired a program from commercial sources; and just as often it means the district has worked out its own program. Among comments: "We're trying out no fewer than four different programs but aren't sure where we're going from there. . . ." Others are sure: "We're laying the basis for a long-range effort to conduct a locally-developed program. . . ." Estimated percent: 5.

curriculum. . . ," "Don't ask us to set up still another new course—this time in thinking. . . ," "Teaching thinking in subject matter—yes; outside of subject matter, no!"

One of the strongest views on this last question was expressed by Superintendent Frank D. Love, Bothell, Washington. In a letter to the editor of this report, Love said:

"Thinking and reasoning skills are the very essence of education. This has been true at least from the time of the Greeks. The idea, however, of teaching thinking and reasoning skills in isolation from content seems to me symptomatic of the educational ills of our time. If we are not already teaching thinking and reasoning skills in mathematics, science, English, and history, then we may be beyond help.

"The effective way to teach thinking and reasoning is in a subject-matter offering. I would oppose involvement in any such simplistic venture as a separate course in thinking and reasoning."

The debate whether thinking skills should constitute a separate program or be infused into the overall curriculum may be one deterrent to the greater acceptance of thinking instruction in the schools. AASA's survey returns reflect a high level of interest, but a relatively subdued level of activity, on behalf of teaching thinking skills. The following questions and answers tell the story:

- Do you have a program of instruction in thinking (any phase) in your school district at this time? Yes, 20 percent; no, 80 percent.
- If no, do you have plans for introducing such a program? Yes, 32 percent; no, 63 percent. (A few gave qualified answers.)
- Do you conduct extra-class activities to promote thinking? Yes, 31 percent; no, 69 percent.
- Has your district developed any instructional materials in thinking skills? Yes, 9 percent; no, 91 percent.
- Has your district set up any inservice programs for thinking skills instruction? Yes, 22 percent; no, 78 percent.

School Districts Are Active—Nonetheless

The above data should not obscure the fact that school districts *are* active in their search for ways to develop the thinking/reasoning student. In some districts the search began two or three decades ago, as the case studies in Chapter 8, "Districts Report Their Experiences" show. Others have joined the search during the past five years; new recruits are coming in continually. As subsequent chapters indicate, some districts buy ready-made programs and packages; others develop programs uniquely suited to local needs. Some districts start slowly, by first involving a small cadre of teachers; others seek districtwide "intervention" programs. The concept that inservice training is of crucial importance in a thinking skills program is gaining strength. And faculty members here and there are developing their own instructional materials—which are under continuous review and revision.

One truth emerging from the AASA survey of the thinking movement is that while cognitive scientists are moving ahead at full steam, school districts are proceeding with caution and with deliberate steps. The majority of school administrators are at a point where they are still asking questions about thinking instruction and searching for ways to develop programs which are uniquely their own and closely tied in with their districts' courses of study.

A Surge of Interest and Spurt of Effort

Many minds, many hands at work on the thinking movement—Surge of interest in thinking is at a high level and rising—Researchers in action—Barrage of books, monographs, and magazine articles—Programs for purchase increasing steadily—National associations gather their forces—ASCD's Collaborative on Thinking—AFT takes a plunge—State education agencies begin to stir.

"The call for attention to higher-order thinking skills rings throughout the educational system," says Edys Quellmalz, Stanford University.

Picking up Quellmalz's figure of speech—the call is heard in research laboratories, on university campuses, at educational associations, and school district offices.

To put it another way, there is a surge of interest in thinking skills—it is at a high level and rising. Here are indicators reflecting the interest and activity:

1. Researchers in action

Scholars, investigators, and the research community are busy on problems related to thinking and how to bring the mastery of its skills into the classroom. Researchers are at work on problems of brain functioning and neurobiology (What is the significance of the left-right brain theme?); on the nature of intelligence (Is it one trait or the product of several? Can it be measured and how?); and on cognitive development (How does intellectual growth proceed from childhood to adulthood?).

There is also intense research activity on problem solving, on creativity and on how one can learn to learn.

Finally, there is a rush to study problems on how to develop intelligent behavior in young people and how to find the methods and materials teachers can put to work for the enhancement of student reasoning, critical thinking, and creative activity.

2. Books and monographs

One result of the research is a flood of scholarly books and monographs—with publishers eager for more. Anyone compiling even a partial bibliography will soon find several hundred items, more than two-thirds of which have been published since 1980. Because of the rising surge of interest, older books, such as John Dewey's *How We Think* (1933) and Gyorgy Polya's *How To Solve It* (1957) are newly in demand. But in demand, too, are new books on artificial intelligence, use of computers, mental tests, and metacognition.

3. Programs, packages, approaches

Another result of recent research into thinking is the growth in programs for teaching thinking. By conservative estimates (1986), there are at least 30 different curriculum programs devoted to thinking on the market, and additional ones appear (again by conservative estimates) at the rate of two or three every six months. Each program serves a different purpose and audience, "is lodged in a different theoretical home," and produces different outcomes. The quoted words in this sentence were often heard at national seminars on teaching thinking conducted during 1986.

The variety and complexity of programs, packages, and approaches offered to school administrators can be baffling (and that is one reason a school district faculty and curriculum leaders must evaluate each offering with care). Some carry clear and simple names, such as Learning to Learn (LTL), Creative Problem Solving (CPS), and Building Thinking Skills. Others are named HOTS (for Higher Order Thinking Skills), Odyssey (by Mastery Education Corporation), and IMPACT (developed by Orange County schools, California). Some programs, such as Structure of Intellect (SOI) go back to 1962; others are as recent as AFT's Critical Thinking Project materials, which in 1986 were in the first stages of application.

That we are at the beginning of an upsurge of additional programs during the rest of the 1980s was suggested by a speaker at a seminar on thinking skills. He said, "Of the making of many books there is no end, according to Ecclesiastes. Soon we shall be saying the same of the making of thinking skills programs."

4. Periodicals

One way to measure the growth of a movement in education is to check the articles on the topic entered in *Education Index* over a number of years. In the past five years, nearly 2,000 scholarly articles have been published about critical thinking and how it is taught in classes from kindergarten through college. During the past three years, the number of articles on thinking has taken a sharp rise. Editors expect this trend to continue.

Leading the way among education periodicals has been *Educational Leadership* (Association for Supervision and Curriculum Development), which published theme issues on thinking in October 1981; in September and November 1984; in May 1985; and May 1986. Other journals giving space to thinking skills articles have been *Phi Delta Kappan* (Bloomington, Indiana), *Social Education* (National Council for the Social Studies), and the *American Teacher* (American Federation of Teachers).

5. Response from associations

Early in 1985, 24 national associations representing major sectors of education formed the Collaborative on Teaching Thinking. (The participating groups are listed in the box on page 16.) box.)

"Talk about a groundswell!" said one representative in the collaborative as its members met to put the resources of their organizations behind the movement.

Leadership for the collaborative came from the Association for Supervision and Curriculum Development. Unanimous agreement on the need and goals for the venture emerged immediately from the groups taking part.

In statements that followed its launching, the collaborative said:

> - Teaching thinking is a new priority for American education. . . . The aim of the thinking skills movement is to promote the teaching of academic content in ways that develop and encourage student thinking. . . . Our idea is not to teach thinking instead of content, but to teach students the intellectual skills they need in order to learn and make use of knowledge. . . .
> - Most new job openings now and in the near future will require people who can reason, analyze problems, and make decisions on the basis of facts. . . . And all citizens, regardless of occupation, should be able to evaluate issues and reach sound conclusions. . . . Unhappily teaching today, for the most part, bypasses reasoning and concentrates on drilling students to recall and repeat the contents of their textbooks . . . but possession of knowledge does not ensure intelligent thinking.

With this manifesto, the collaborative pledged that it (1) would help curriculum planners to include thinking skills in elementary and secondary school offerings; (2) would suggest changes in preservice and inservice teacher education that will enable teachers to promote thinking in the classroom; (3) would ask publishers of textbooks and tests to include material that will contribute to student thinking; (4) would promote research; and (5) would solicit public support for teaching thinking.

Members of the collaborative, for their part, indicated that they would encourage their organizations to publish more articles about thinking in their journals and newsletters. They also pledged they would push for the production of books, monographs, informational leaflets, video- and audiocassettes, radio and TV programs on the topic and incorporate more sessions on all aspects of thinking in their meetings and conventions.

AFT and NEA Act

One of the most extensive responses to the need for incorporating thinking skills instruction into schools came from the American Federation of Teachers. AFT President Albert Shanker announced (1985) that his union is "making the development of critical thinking skills among students and teachers one of its top priorities." He followed this up by setting up the AFT Critical Thinking Project and placing Dr. Debbie Walsh, from AFT's Washington staff, in charge. Shanker's actions were accompanied by such statements as:

"Our children are not adequately prepared for the demands of our rapidly changing world. . . .

"The amount of information, misinformation, and disinformation that constantly bombards us suggests that never before have skills in rational thought and reasoned judgment been so urgently needed. . . .

"A true commitment to critical thinking will require major organizational changes in schools if we are to create environments where students and teachers are valued as critical thinkers—environments where asking the right questions is as important as giving the right answers."

Shanker promised that the AFT will produce a series of booklets dealing with instruction of critical thinking skills and will develop materials for teachers to "assist them in developing and integrating critical thinking skills in their classrooms." Also promised were videotapes for teaching thinking in grades K through 12.

Possibly the most expansive of the proposed actions by AFT was a series of "training sessions for teachers to train other teachers"—which, in time, would take in all of AFT's 2,200 locals. As a first step, AFT set up a pilot program for "training of trainers" in the Hammond, Indiana, school system. The training of trainers is based on the following premises:

"Schools must move away from the one-right-answer approach and the overemphasis on a curriculum that burdens the student with unorganized, perishable, and obsolescent assemblage of facts. . . .

"There is no one right way to teach critical thinking and teachers should have freedom to select the teaching strategies appropriate for them. . . .

"Critical thinking needs to be integrated into existing curriculums and content areas, not taught as a separate, formalized course."

The National Education Association published a 50-page monograph, "Critical Thinking Skills" (1985). The monograph is designed primarily for teachers. It reviews research in critical thinking skills and discusses skills that can be incorporated in classroom teaching. Administrators may find of interest a list of 11 programs commercially available to schools interested in improving student thinking skills. The authors, Marcia Heiman and Joshua Slomianko, both from Massachusetts, disagree sharply with those who advocate teaching intellectual skills in isolation from content. "This implies that no one has ever thought creatively in a content area, that academic learning itself is somehow suspect. . . ," the authors say.

The NEA claims it began focusing on critical thinking in 1979 with a booklet entitled *Teaching Styles as Related to Student Achievement*. In 1982, the critical thinking series was extended with three publications: *Cooperative Learning*, *Questioning Skills for Teachers*, and *Language Skills in the Classroom*.

In September 1986, NEA completed its project on critical thinking by publishing a multimedia training program that features audio videotapes, filmstrips, workshop designs to train teachers and materials designed for parents.

6. The states respond

A decade ago, state legislatures and state education agencies barely recognized thinking skills as a concern for the public schools. By 1986, nearly all states reported they were "discussing," "studying," or "considering" the theme. However, a substantial number of states pointed to solid achievements. This and other evidence, outlined below, came from surveys by the Education Commission of the States, the American Federation of Teachers and from the AASA survey for this report.

Here is the pattern of state actions and efforts as they unfolded for the last half of the 1980s:

- Developing inservice programs for classroom teachers—Alaska, Utah, Wyoming
- Developing statewide curriculum guides and courses of study reflecting increased attention to critical thinking in reading—Arizona, Arkansas, Nevada, Tennessee
- Developing objectives for instruction in critical thinking skills—Michigan, Missouri, New York
- Developing publications, teacher guides, and videotapes—Ohio, Vermont, Virginia
- Leading the way in assessment of thinking skills—California, Connecticut, Michigan, Pennsylvania (see Chapter 10 for discussion).
- Implementing state laws promoting critical thinking instruction—North Carolina, South Carolina, Texas, Wisconsin.

California educators pointed to what they call extensive actions taken or planned to advance critical thinking instruction. The college and university systems in California instituted a graduation requirement in critical thinking for all students. The state department is going ahead with plans for revisions in textbooks, curriculum, staff development, and teacher education. Statewide tests in language arts, mathematics, and social studies contain items that test critical thinking skills.

Connecticut state level officials have embraced the principle that "classroom instruction in all areas should foster thinking skills such as recognition of fact relationships, critical reasoning, and problem solving." When mastery tests for all fourth-, sixth-, and eighth-grade students revealed deficiencies in thinking skills in reading, writing, science, and math, State Education Commissioner Gerald N. Tirozzi set in motion plans to help school districts "place greater emphasis on development of broader understanding of concepts."

Pennsylvania has made development of thinking skills one of the state's 12 educational goals. Officials are identifying schools with exemplary thinking skills programs to serve as models. A newsletter on thinking with statewide circulation, state-sponsored conferences on "The Student As Thinker," and updated resource guides are additional measures designed to help local districts make thinking skills a high priority.

More Indicators of Interest

Hardly a day passes that does not bring new facts or developments reflecting the growing in-

A Gathering of Forces

Members of a Collaborative on Teaching Thinking, as constituted in November 1985, are listed below. If you are a member of an association participating in the collaborative, you may wish to get the latest information on what your group is doing to upgrade the teaching of thinking skills by contacting your national, regional, or state organization. For general information on the collaborative, write ASCD Collaborative, 125 N. West St., Alexandria, VA 22314.

The participating organizations are: American Association of Colleges for Teacher Education, American Federation of Teachers, American Association of School Administrators, American Educational Research Association, Association for Supervision and Curriculum Development, Council of Great City Schools, Home Economics Education Association, Institute for Development of Educational Activities, International Listening Association, International Reading Association, Music Educators National Conference, National Art Education Association, National Association of Black School Educators, National Association of Elementary School Principals, National Council for the Social Studies, National Council of Teachers of English, National Council of Teachers of Mathematics, National Education Association, National School Boards Association, National Science Teachers Association, National Congress of Parents and Teachers, National Association of Secondary School Principals, and National School Public Relations Association.

terest in thinking skills. From a gathering of evidence come these items.

- Institutes and conferences sponsored by universities and professional associations are growing in number. One estimate holds that during 1986, 50 such institutes attracted close to 5,000 educators. Examples: Institute on Critical and Creative Thinking, Harvard University; Conference on Critical Thinking and Educational Reform (this was the fourth annual meeting), Sonoma State University. The Association for Supervision and Curriculum Development held 11 institutes (San Francisco; Washington, D.C.; Atlantic City; Williamsburg, Virginia; and Anaheim, California). Phi Delta Kappa sponsored institutes on critical thinking during 1986 in Birmingham, Alabama; Rochester, Minnesota; Wheaton, Illinois; Pittsburg, Kansas; and Memphis, Tennessee.
- Close to two dozen newsletters are in circulation, sponsored by private individuals, producers of cognitive materials, and public agencies. Examples: "On the Beam," published by New Horizons for Learning, Seattle, Washington; "Cognition and Instruction," by Lawrence Erlbaum Associates, Hillsdale, New Jersey; "Thinking Skills Newsletter," by the Pennsylvania State Department of Education, Harrisburg.
- A nationwide network for individuals concerned with thinking skills is enrolling new members every month. The Thinking Skills Network, conducted by John Barell, Montclair State College, Upper Montclair, New Jersey, also publishes a newsletter, "Cogitare," available by subscription.

Message from research

The amount of time that the teacher allows between the completion of the question and the student response influences student performance.

> By waiting the necessary three to five seconds for the student to begin the response, the teacher can: (1) increase the length of the response; (2) receive more solicited responses; and (3) improve student confidence.

Source: M. Rowe, "Wait-Time and Rewards As Instructional Variables. . . ," *Journal of Research on Science Teaching*, February 1974.

3 *THE INFORMATION SOCIETY*

The Demand For Minds To Cope With Facts: Who Started the Movement and Why

Arousing the nation's schools to the importance of critical thinking—What leaders in sociology, economics, and industry say—The call for reform in education rings loud—Instruction in thinking is *in:* the basis for an information society

Two cadres of leaders aroused the nation's educators to the importance of developing critical thinking skills in students:

1. The first cadre is made up of men and women from sociology, economics, and industry who proclaim that the 21st century is taking us toward a society whose basic values are not land or labor, backbreaking work or manual skill but, instead, will center on information and on the individual's ability to manage it. The names of Daniel Bell, Alvin Toffler, and John Naisbitt caught the popular eye and ear. But the idea is now expounded and documented by hundreds of scholars, futurists, industrialists, orators from corporations, and writers for journals and newspapers (the *Harvard Business Review* and *Wall Street Journal*, for example).

2. The second cadre takes in men and women who, during the past decade, have produced a series of documents that will long be known in our history as "reform" or "excellence" reports. The names of Ernest Boyer, John Goodlad, and Mortimer Adler, to mention but three, stand out among the authors. Challenging proposals came also from committees and commissions sponsored by prestigious educational and science-oriented associations.

Let's look more closely at the ideas stemming from these two cadres—whether you call them prophets and seers or reformers and scholars.

"Scholarly" is one word that describes *The Coming of Post-Industrial Society*, the 1973 book by Daniel Bell that set a trend for forecasting the nature of life, industry, and education in the years ahead.

Bell sets forth the following historic "schema" for social change:

Pre-industrial stage: Farming, mining, fishing, timbering are among the prime industries; the farmer, miner, fisherman, and unskilled worker constitute the bulk of the labor force. They work with the raw materials wrested from the earth. Common sense and traditional experience are the bases of their methodology. Reading, writing, and arithmetic are valued for their utility. This was the stage of America's early years as a nation; it is the stage still found in parts of Asia, Africa, and Latin America.

Industrial stage: Manufacturing, processing, goods-producing are major occupations. Semi-skilled workers, technicians, and engineers are highly valued. They rely essentially on energy (electricity, water) rather than on power generated by man or beast. Inventiveness, experimentation, trial and error are at the core of their methodology. Schools are asked to develop trained workers through vocational education, technological institutions, and career-oriented courses in colleges and universities. The Soviet Union and Western Europe are in this stage of their development; as are "pockets" of United States enterprise.

Post-industrial stage: Delivery of services (and a diminution on emphasis of producing goods) are of first concern. Preeminent activities deal with transportation, utilities, trade, finance, health, education, research, government, and recreation. Scientists, as well as professionally- and technically-trained workers dominate the labor force. Knowledge, data, information constitute the capital of the post-industrial stage. Leadership goes to those who can expand information, who can analyze it, derive abstract theory, use it for making decisions and planning future goods and services, and for developing new generations of technologies. Schools and colleges are looked upon as the source of individuals who can generate, absorb, and process information. The United States, some countries in Western Europe and Japan have already been touched by the post-industrial stage—and some say that Japan has moved into a stage even beyond that.

A cohort of sociologists, scientists, and educators agree with Bell's basic "schema." They have elaborated on it, changed it somewhat, extracted new concepts from it. For some, "the post-industrial" society became "the information society," a term preferred by John Naisbitt, whose 1982 book, *Megatrends*, became "must" reading for policy-makers and administrators in industry and education.

Marshalling theory, fact, and forecast, Naisbitt professed that:

- Information is the new, strategic resource of American civilization, its new capital, its new source of power.
- Information, or to change the term somewhat, knowledge, is the driving force of our economy.
- Information (or knowledge) is the base of our primary industries—the key to productivity, competitive strength and economic achievement.
- Nearly two-thirds of Americans today work in jobs involving the creation, processing, and distribution of information. Lawyer, teacher, bureaucrat, manager, banker, or technician—millions upon millions—are already in the "thinking business." As new information technologies are applied to old industrial tasks, many more wage earners—machinists, welders, insurance agents, production workers—will work themselves out of manufacturing and into "the thinking business."

The term "the thinking business" comes from David Birch of MIT. He used it to underscore his belief that the shift from an industrial society to an information society is also a shift from "a labor-intensive to a literacy-intensive society, where not brawn but brain, not manual skill but informational skill, are the prime needs." Such a society will depend on individuals with ability to think, to reason, to solve problems, to analyze, to compare, to generalize, to absorb existing information, and to create new information.

Turning now to the cadre of experts who pointed to the new importance of thinking skills in the young people who will live and work in the 21st century, we first come to the authors of *A Nation At Risk: The Imperative for Educational Reform*. Prepared by the National Commission on Excellence in Education (1982), this report, among the spate of "reform" or "excellence" statements that came off the presses in the early 1980s, had a strong impact on educational policy and on the importance of teaching for "higher literacy." *A Nation At Risk* makes these recommendations for core subject areas.

1. The teaching of English in high school should equip graduates to: (a) comprehend, interpret, evaluate, and use what they read; (b) write well-organized, effective papers; (c) listen effectively and discuss ideas intelligently.
2. The teaching of mathematics in high school should equip graduates to: (a) understand geometric and algebraic concepts; (b) understand elementary probability and statistics; (c) apply mathematics in everyday situations; and (d) estimate, approximate, measure, and test the accuracy of their calculations.
3. The teaching of science in high school should provide graduates with an introduction to: (a) the concepts, laws, and processes of the physical and biological sciences; (b) the methods of scientific inquiry and reasoning; (c) the application of scientific knowledge to everyday life.
4. The teaching of social studies in high school should be designed to: (a) enable students to fix their places and possibilities within the larger social and cultural structure; (b) understand the broad sweep of both ancient and contemporary ideas that have shaped our world; (c) understand the fundamentals of how our economic system works and how our political system functions; and (d) grasp the difference between free and repressive societies.

> 5. The teaching of computer science in high school should equip graduates to: (1) understand the computer as an information, computation, and communication device: (b) use the computer in the study of the other basics and for personal and work-related purposes: and (c) understand the world of computers, electronics, and related technologies.

Next came (1983) *Action for Excellence: A Comprehensive Plan to Improve Our Nation's Schools*, with this recommendation:

> "Technological change and global competition make it imperative to equip students in public schools with skills to go beyond the basics."
>
> *Action For Excellence* went on to say:
>
> ". . . Overall performance in higher-order skills—inference, analysis, interpretation, and problem-solving skills—declined in the 70s. And the largest drop-offs in achievement occurred in the most able students. This suggests that we may be regressing from the standard of literacy which was considered adequate 15 years ago at precisely the moment when global economic competition and technological change in the workplace are challenging us to upgrade our standards.
>
> "These educational deficits are hardly surprising when we reflect that among the world's industrialized nations, the United States appears to expect the least of its youth in terms of academic effort and achievement."

Specifically addressing thinking skill development, The College Board published *Academic Preparation for College* (1983) calling on schools to develop the following reasoning components for students:

- The ability to identify and formulate problems, as well as the ability to propose and evaluate ways to solve them.
- The ability to recognize and use inductive and deductive reasoning, and to recognize fallacies in reasoning.
- The ability to draw reasonable conclusions from information found in various sources, whether written, spoken, or displayed in tables and graphs, and to defend one's conclusions rationally.
- The ability to comprehend, develop, and use concepts and generalizations.
- The ability to distinguish between fact and opinion.

With a new report devoted to the problems in schools being published at regular intervals, educators were relieved to see a listing of skills which they could sink their teeth into. School personnel used the College Board document as a vehicle for comparing current curriculum practices with what "should exist."

Mortimer Adler's *Paideia Proposal* (1982), emphasized the teacher and student roles in thinking skills development:

> All genuine learning is active, not passive. It involves the use of the mind, not just the memory. It is a process of discovery, in which the student is the main agent, not the teacher. . . .
>
> How should teachers—functioning properly as aides to learning—work to guide or assist the activity of the pupil's mind, the activity that is the principal cause of learning? The answer differs according to the three ways in which learning improves the mind: (1) by the acquisition of information or organized knowledge; (2) by the development of intellectual skills; (3) by the enlargement of the understanding. In each of these three modes of learning, there is a different kind of help to be given by the teacher. . . .

Of greater concern to the public and to educators were mathematics and science. A number of reports hammered away at America's disadvantage in each of the two disciplines.

One document, devoted exclusively to these two areas of concern, *Educating Americans For the 21st Century* by the National Science Board Commission, told what needed to be done to correct a dangerous situation. Said the report:

> Simply put, students in our Nation's schools are learning less mathematics, science, and technology, particularly in the areas of abstract thinking and problem solving.

Also in 1983 two highly influential books were published. The first, *A Place Called School* by John Goodlad, summed up Goodlad's research during the 1970s and 1980s. *A Place Called School* left a significant impression in the minds of educators. In this book, Goodlad argues for a curricular core that emphasizes a common set of concepts, principles, skills, and ways of knowing.

However, the book that most strongly promoted thinking skills instruction was *High School* by Ernest Boyer, published by Harper and Row.

First among goals Boyer proposes for the high school is this one:

> The high school should help all students develop the capacity to think critically and communicate effectively through a mastery of language.

Later in the book Boyer asserts:

> Clear writing leads to clear thinking; clear thinking is the basis of clear writing. Therefore, all high school students should complete a basic English course with emphasis on writing.

And in 1984 came Theodore Sizer's *Horace's Dilemma*, with this piece of advice:

> Higher-order thinking skills—reasoning, imagining, analyzing, synthesizing—are the core of senior high school work, and they are learned through confrontation, through dialogue. One isn't told how to think; one reasons and has that reasoning critiqued. Inescapably, this process requires different kinds of teaching formats and lower teaching loads than are now the rule.

The wave of reports published in less than three years rekindled an awareness to teach thinking that had become somewhat buried during the "back to basics" movement of the 1970s. Many school districts that had abandoned inquiry as a foundation of the curriculum began to see the importance of thinking instruction. Without question, the words and ideas cited in this chapter had their effect—"this thinking business" is *in*.

Teaching Thinking and Reasoning... Public Relations Considerations

Our Nation has grown and prospered because of its creative genius. The thinking and reasoning skills of our people have been the driving force, stimulating our dynamic society. Yet, some people feel it is wrong to teach children to think and reason for themselves, who feel that children should simply do as they are told.

A sound program for teaching thinking and reasoning skills in the schools should be accompanied by a thoughtful communications plan. Consider the following:

- Review national, state, and local studies and reports on education indicating the need for students to develop thinking and reasoning skills.
- Conduct a survey or include in your annual community/staff survey an opportunity for respondents to comment on the importance of thinking and reasoning skills for students.
- Involve staff and community in developing or selecting the best program for your school system.
- Ask the school board to give its support to the program, perhaps through policy.
- Ensure that staff members who will be responsible for making the program work are well trained. Continue to update that training with present and new staff.
- Communicate concrete examples of how students are learning critical thinking and reasoning skills. Let staff and community know through the news media, school newsletters, slide and video programs, presentations before community groups and other channels.
- Regularly evaluate the program and use results to make the program even more effective.

A sound program for teaching thinking and reasoning skills will not only help students but will also show the sensitivity of your school system in meeting important needs of today's children and youth who will become tomorrow's leaders.

Pioneers and Practitioners: Men and Women Who Determine the Course of Thinking Instruction

It may have started with Socrates, but modern-day cognitive scientists now shape the concepts on thinking instruction—Pioneers and trailblazers—A partial list of leaders in the thinking movement—How school district practitioners contribute to development of instructional models—What are the next steps in the movement?

If you asked 100 educators "Who is the patron saint of thinking?" a sizable number might answer Socrates. Ironically, the Socratic mode of inquiry has had little exposure to the students of America. Others might answer Dewey; but an entire generation of educators has grown up without being affected very much by Dewey's philosophy.

Who, then, have influenced most intensively the direction that thinking skills instruction takes within our schools? The answer lies in a three-tiered response. In tier one are the pioneers in thinking instruction. In tier two are today's experts who develop cognitive theories and teaching models, and spread their thinking gospel and their products from sea to shining sea. In the third tier are school personnel who know something about the pioneering work in thinking, listen to the experts, and then try to define programs for their district.

Pioneers Leading the Way

The starting lineup for tier one must include these three names, among others: Benjamin Bloom, Hilda Taba, and Jerome Bruner. Of these three, Bloom has likely had the most widespread effect on school thinking skills instruction. In 1956, Bloom published his *Taxonomy of Educational Objectives, Handbook I: Cognitive Domain*. The taxonomy divides cognitive understanding into six categories, and Bloom sets forth the principle that the student must be successful with each in order to use his or her full capacity for thinking. They are:

Knowledge—recalling or locating of information
Comprehension—understanding and explanation of facts
Application—using prior learning to solve a problem or to answer a question
Analysis—seeing in-depth relationships between and among parts of the information
Synthesis—creating new ideas by pulling parts of the information together
Evaluation—making judgments based on evidence.

The work of Hilda Taba, which flourished about 1967 with the publication of her *Handbook for Elementary Social Studies*, is much more readily translatable for the classroom teacher than Bloom's taxonomy. Taba identifies both thinking stages and teacher strategies for thinking instruction. Although her approaches and strategies are designed for social studies instruction, they can be applied to other content areas.

Taba's cognitive model includes these stages:

- Stage one—Concept formation (identifying, grouping, categorizing)
- Stage two—Interpretation of data (interpreting, inferring, generalizing)
- Stage three—Application of principles (hypothesizing, explaining, verifying predictions)

The work of Jerome Bruner has proved valuable for those who want to gain an improved understanding of the thinking process. Bruner (with J. Goodnow and G. Austin) wrote *A Study of Thinking* (1956). This book presents four phases of cognitive skills for students to master:

- Phase one—Presenting information (the learner speculates about the concept)
- Phase two—Analyzing strategies (the learner determines how he or she is going to alter the concept)
- Phase three—Analyzing concepts in written material and from conversation (the learner reads and or listens and then groups according to the concept)
- Phase four—Practicing (the learner forms concepts and defends them)

Today's Leaders

The experts of tier two are contemporaries of some of the "old timers." Their influence in the present-day marketplace of ideas on thinking does not come solely from borrowing or adapting the concepts originally developed by Dewey, Bloom, Taba, Bruner, and others. The present generation of leaders who think about thinking includes men and women who base their concepts on new research—or, as is the case with deBono, on inspiration. Here is a short roll call, in alphabetical order, of notables in the field:

BARRY K. BEYER—Professor of education, George Mason University, Fairfax, Virginia . . . author of influential articles on thinking published in *Educational Leadership, Social Education*, and *Phi Delta Kappan* . . . frequent speaker at seminars and institutes on thinking . . . consultant to school systems and state education agencies . . . believes that "commercial programs on thinking can't do the job alone; that local school systems must integrate thinking across the curriculum."

SANDRA BLACK—College professor, elementary classroom teacher, and consultant on thinking . . . travels widely, advising school districts on designing thinking programs . . . author, with husband, Howard Black, of *Building Thinking Skills* (Midwest Publications, Pacific Grove, Calif.). Contact: P.O. Box 468, St. Augustine, FL 32084.

ARTHUR L. COSTA—Professor of education, California State University, Sacramento . . . active as speaker, writer, consultant . . . author of *Developing Minds* (ASCD, 1985), a distillation of "all we know at present about thinking and its application to learning and teaching" . . . advocate of thinking "across the disciplines," stressing interrelationships between thinking and the arts, language, social sciences, mathematics, science, and physical education.

EDWARD DEBONO—Internationally recognized authority on creative thinking . . . developed concept of lateral thinking for solving problems in industry and education . . . author of two dozen books, including *The Use of Lateral Thinking* (paperback, Penguin, 1967) . . . offers package of "thinking lessons" to schools under the title the CoRT Thinking Program . . . serves as consultant, lecturer, director of workshops. Contact: Pergamon Press, Fairview Park, Elmsford, NY 10523.

ROBERT H. ENNIS—Pioneer in thinking movement since 1960 and still at it . . . published one of earliest influential articles on the topic "A Concept of Critical Thinking" (*Harvard Educational Review*, Winter 1962) . . . at present, director, Illinois Critical Thinking Project and professor of philosophy, University of Illinois, Urbana-Champaign . . . author of major tests on thinking . . . consultant to state education agencies—e.g., Connecticut Department of Education.

REUVEN FEUERSTEIN—Developer of Instrumental Enrichment program to help students become better learners through improved thinking skills . . . an Israeli, has worked in the U.S. for more than a generation on his program . . . describes theoretical basis on his program in *Instrumental Enrichment: An Intervention Program for Cognitive Modifiability* (University Park Press, Baltimore, MD, 1980). Contact: Curriculum Development Associates, 1211 Connecticut Ave., N.W., Washington, DC 20036.

WILLIAM J. GORDON—Designer of Synectics, a program for improving comprehension and creative thinking through analogies . . . former Harvard University professor . . . author, with Tony Poze, of *Art of the Possible*, a training guide for use of analogies, and *Strange and Familiar*, a program that teaches students how to use analogies. Contact: Synectics Educational Systems, 121 Brattle St., Cambridge, MA 02138.

MATTHEW LIPMAN—Professor, Montclair State College, New Jersey . . . author of *Philosophy for Children*, a widely respected program to promote reasoning . . . Lipman maintains reasoning skills learned as a child become core of reasoning as an adult . . . his own philosophy: "Thinking is more basic than reading."

RAYMOND NICKERSON—Associated with Harvard University . . . researcher, author, seminar leader on thinking . . . principal author, with David Perkins and Edward Smith, of *Teaching Thinking* (Academic Press, 1985), which discusses nature of intelligence, errors, and biases in reasoning . . . is recognized as competent reviewer of available programs for training in thinking skills.

DAVID N. PERKINS—Codirector, Harvard Project Zero, Cambridge, Massachusetts . . . "Wherever there is a seminar on thinking, you're likely to find Perkins" . . . major work: *The Mind's Best Work: A New Psychology of Creative Thinking* (Harvard University Press, 1983) . . . major contribution: his theory that critical and creative thinking are not antagonistic, but are co-related . . . recognized as a leader among advocates of infusion of thinking skills in school curriculum.

ROBERT STERNBERG—Professor of psychology, Yale University, New Haven . . . has conducted extensive research on relationship of intelligence and thinking . . . promotes a methodology for moving from the theory to practice . . . in demand as consultant, speaker, and workshop director . . . author of six major works on intelligence, including *Advances in the Psychology of Human Intelligence* (Erlbaum Associates, 1984).

The Eclectics in Action

Present-day specialists on thinking (and there are many more than those listed above) have individual and unique perspectives on thinking instruction. The differences in their philosophy are indicative of a problem that school districts face: How to translate what the experts say into classroom practice?

Here, then, we come to the third tier of workers in the cognitive field—school district staff members who have ventured into the field and are developing their own schemata for teaching thinking skills. Some of these district practitioners have tried to solve their problems by purchasing the packaged materials developed by one of the second-tier experts and adapting them for local use. Other practitioners have selected one or another cognitive model from experts as the cornerstone of an in-house designed program; or they have combined two or three thinking theories into a plan and program that suit their needs.

Some examples:

- *The Montgomery County, Maryland, Public Schools have determined that there are five higher order intellectual skills that students need:*

1. Ability to identify and conceptualize problems and to generate and evaluate alternative solutions
2. Ability to identify and use inductive, deductive, and analogical reasoning and to recognize the interaction among these processes
3. Ability to draw conclusions based on analysis and evaluation of information, and to justify and defend these conclusions
4. Ability to comprehend, develop, and integrate concepts and generalizations
5. Ability to generate new ideas and products.

- *The Valley Educational Consortium, McMinnville, Oregon, which represents many districts and service centers, identifies three areas of reasoning skills: (1) critical thinking, (2) creative thinking, and (3) problem solving. For each area the consortium has designed specific goals:*

Goals for critical thinking

- The student will be able to draw valid inferences, generalizations, analogies, and conclusions.
- The student will be able to build logical arguments, explanations, and predictions.
- The student will be able to evaluate arguments, explanations, and predictions critically.

Goals for creative thinking

- The student will be able to discover meanings and patterns in experiences.
- The student will be able to view and interpret experiences from a variety of perspectives.
- The student will be able to draw connections between, and integrate, two or more bodies of knowledge.

Goals for problem solving

- The student will be able to clarify problems before working toward and implementing solutions.
- The student will be able to design and implement a plan for solving a problem or deciding upon a course of action.
- The student will be able to evaluate the adequacy of a problem solution or decision made and respond constructively to evaluation results.

- *The Lyndhurst, New Jersey, schools have defined eight behaviors that are crucial to effective thinking.*

People use critical thinking when they are:

1. Open-minded about new ideas
2. Know when more information is needed
3. Know the difference between a conclusion that might be true and one that must be true
4. Know the different perceptions of words
5. Try to avoid common mistakes in their own reasoning
6. Question everything that doesn't make sense or is not logical
7. Try to separate emotional thinking from logical thinking
8. Don't argue when they don't know anything about the topic.

These examples from school districts illustrate that many of them are at a pick-and-choose stage of thinking skills programs. However, there are enough clues in the AASA survey for this report to indicate that the district programs which have developed through eclecticism will soon undergo revision and strive for a new stage in sophistication.

Backdrop For Action in Meeting the Challenge of Thinking Skills Instruction

Interview with Ronald S. Brandt, advocate of thinking instruction—Danger of oversimplification—Teaching *of, for,* and *about* thinking—Is thinking a separate course or infusion of skills in all content?—Those commercial programs: How sound, how useful?

Why the surge of interest in thinking skills? What are the pitfalls in the paths of educators developing thinking skills programs? What are the distinctions of teaching *for* thinking skills, *of* thinking skills, and *about* thinking skills?

These are among the questions taken up by Ronald S. Brandt in an interview for this publication. Brandt is both an ardent advocate of thinking instruction in the schools of America and a close observer of the movement. As executive editor of *Educational Leadership,* he has published scores of articles over the years on many aspects of thinking. His base is the Association for Supervision and Curriculum Development, Alexandria, Virginia.

Why the surge of interest in thinking skills?

I think it grows out of a recognition of what Lauren Resnick of the University of Pittsburgh calls "higher literacy." Until now, people have been concerned with a kind of "lower literacy." Now, the population is more aware of the need to think—and think critically and creatively—in our complex world. In the future, people will not be able to make it in the middle class without having this higher literacy.

A second factor is that students are not doing well on thinking skills. Data from the National Assessment of Educational Progress clearly show that this is a problem.

A third reason has to do with research. The thinking movement wouldn't be what it is if educators didn't have "new tools." Today we have dozens of programs that teach or are designed to teach thinking skills. Some of these programs began as research projects. From the research came new materials for instruction. There is a new body of content that is based on research, and educators cannot ignore this fact. For example, Robert Sternberg, of Yale University, has been researching how the brain operates. Through his research we will have a clearer understanding of a model of brain functioning. As a result, educators may be able to do a better job in teaching about the thinking processes.

What is your biggest concern about the new emphasis on thinking skills?

I am concerned that we may oversimplify the process of teaching how to think. I am worried that we might reduce thinking to a mechanical set of skills, such as are thought to exist with other processes. For example, reading is thought of as a process consisting of a cluster of skills. Certainly, the skills are a valid part of instruction. However, reading needs to be viewed as an exciting process from which the reader gains meaning. What worries me is that teachers will look for a set of thinking skills rules or tips to be placed, say, on yellow cards, and will check off a specified skill as they "cover it." Then, unhappily, the teacher will conclude: "Yes, my students know how to think."

Many teachers say they have been teaching thinking skills all along. Is this an accurate statement?

I make three distinctions. There is teaching *for* thinking skills, teaching *of* thinking skills, and teaching *about* thinking skills. Good teachers have been teaching *for* thinking skills. These teachers pose tough questions which encourage or impel students to think. But teachers, in these instances, call upon students to perform a task without showing them how. In other words, they are asking the students to think but are not giving them an understanding of how to think. The same kind of situation may happen with writing instruction. Some students are expected to write without receiving instruction. If their ability to write improves, it only improves because of practice or chance.

Teaching *of* thinking is a second phase of the larger problem of helping students master the art of thinking. In this phase, teachers would instruct students directly in the process of thinking. They would show students what specific cognitive skills are involved. Is it making comparisons? Is it inferring? Is it synthesizing? Is it evaluating? Yes, all these—and more and others. And the teacher would show how these skills can be put to work in, say, reading, social studies and other subjects.

And third, there is teaching *about* thinking. One of the components in this phase is teaching how the brain functions. And how does memory work? Why do we dream? How do we learn? These questions lead us to others: Can we learn how to learn? How best to study for a test? How to find out whether a student learns best visually, auditorily, kinesthetically?

Is it realistic to expect that our teachers can teach *for* thinking, *of* thinking, and *about* thinking?

It is a big challenge, requiring years to achieve, even partially. Certainly, teaching *for* thinking is a practical goal—reachable and doable, so to speak, and as we've seen, good teachers have been doing that. To elaborate that a bit, teaching *for* thinking simply means that teachers pose problems, raise questions, value student responses, make time for them, allow students to take risks, encourage them to be experimental. And for administrators, this calls for encouraging teachers to create and maintain the kind of classroom and learning environment I just described.

As for the other two phases—teaching *of* thinking and teaching *about* thinking—there is help from programs and packages now in the marketplace—and more to come in the years ahead.

Behind this discussion there still lurks the question: Should thinking skills be taught as a part of the existing content curriculum or should they be taught separately?

There are advantages and disadvantages to either path. If a school district teaches thinking skills separately, teachers and administrators may find it an easier road because the thinking skills program will not conflict with existing subject matter goals and objectives. In addition, inservice may be less overwhelming for teachers because they do not have to be concerned about redesigning their existing subject-matter courses. On the other hand, there are disadvantages to teaching thinking skills separately. If thinking is taught separately, only a limited number of teachers are probably involved. Then there is the transfer problem. Is it desired that students transfer their skills so they can apply thinking strategies during content instruction? If the answer to this question is Yes, then all teachers must understand how to help students transfer the skills they learn in the separately taught thinking program as they study other subjects.

How useful are commercially published thinking skills programs?

Again, there are advantages and disadvantages. Commercially published programs have usually been tested to some degree and are likely to be effective. In some cases, these programs have a very sound theoretical base, which is clearly an advantage. The student activities presented in published programs may be less conventional, less routine and therefore more challenging for students.

One clear disadvantage, however, is that it may be very difficult to integrate the content of the published programs into the school district curriculum.

What are some general problems that school administrators encounter in designing and developing thinking programs?

Some school administrators may not appreciate how complex and difficult a process it is to design a thinking skills program. There have been instances where administrators have charged a committee to draft a thinking skills program in a few weeks. These administrators have probably underestimated the complexity of the task.

Another point: Administrators sometimes have not fully understood the importance of getting the whole school system involved at the planning stage. Too often, when administrators assign a committee to develop a program for the system, the committee will wind up with a course on Bloom's Taxonomy and procedures for teacher questioning. There is nothing wrong with this, but it is just not enough.

I'm reminded of the situation we experienced in the late sixties and early seventies in social studies. With the vast amount of social studies curriculum materials that had been developed, no one knew how to put them together. There were so many pieces to the puzzle that teachers and administrators needed to work together to decide which pieces best suited their district. There was more social studies material available than could be used. Something of the same conditions exist with regard to thinking instruction. There is a lot "out there." Each school district must look deeply into research findings; into programs available in the marketplace; and into the experiences of school districts as they develop their own approaches and materials. Then—pick and choose, adopt and adapt.

How much of a problem is it for school administrators to select the "right" program?

It's a complicated problem. One has to eliminate some of the complexity in order to say: "This is a program that will work in my district."

My effort has been to encourage people to be fully aware of the wide range of possibilities before they do any narrowing down. There are now dozens of approaches. Some of these approaches are contrary to each other. It is valid for school people to say "I can't do it all. Therefore, I am only going to do this much within my school or school district. I am only going to do the programs or approaches which will be most productive." However, this type of statement can only be made when school district personnel can intentionally and knowingly be aware of what they are including in their program and what they are excluding.

What criteria should be used to select a published program?

The program needs to be used on a theory of intellectual performance that has been verified. The program must be a product of careful development and evaluation.

It should be suited to the cultural background and developmental levels of students; and it should be suited to the capabilities of teachers. Administrators making the selection should look for programs that can offer statistically significant results and anecdotal evidence of success.

What are the factors that may prevent students from developing their thinking skills ability?

One factor is the tradition of what constitutes teaching. Part of that is the pressure on teachers to test for knowledge and skills. They feel obligated to give students the necessary information, so as to meet the immense pressure on students to succeed on these tests. Another factor discouraging thinking among students is the existence, in some communities, of pressure groups that attack the concept of promoting thinking in the classroom. In some communities, these are hard times for winning the commitment of staff to instruction of thinking skills. Finally, a practical disadvantage may be that thinking skills programs tend to be expensive, that is, if administrators go into the marketplace to buy commercially-produced packages. Of course, that is not always necessary or essential.

Mini-Interview with David Perkins, Harvard University

Is a school district better off teaching a separate thinking course or integrating thinking instruction into existing curriculum?

There are trade-offs going one way and going the other. One of the principal trade-offs is trading depth for breadth. If you want strong gains in math, it is far better to integrate thinking into the math course, but you may not get much payoff in English or history or biology. On the other hand, if you want across-the-board gains, you can try to teach a general course in thinking skills. [In this case] you may get a modest payoff across a number of subjects.

Some school systems base their thinking program on Bloom's Taxonomy. Is this a smart thing to do?

Teachers who know about Bloom's Taxonomy rarely succeed in infusing instruction with higher-order questions. If you want to boost thinking skills, you must teach students strategies or frameworks that explicitly support effective thinking. Bloom's Taxonomy may help to set a goal, but it doesn't guide a process of thought. It is not a good basket to put all your eggs in.

About that much used, as sometimes much abused term "critical thinking": What are your reactions to the term?

Critical thinking has become a somewhat hot term. Some people want to jump on the band wagon but also want to include things that are not part of critical thinking in the broad sense. Some people believe that critical thinking and creative thinking are intertangled.

The concept of critical thinking originally referred to evaluating things analytically. In recent years, there has emerged a tendency to view critical thinking as most any sort of thinking, including creative thinking, problem solving, or decision making. Some people use critical thinking in the broader sense and some use it in the narrower sense of analytical evaluation.

You talk about creative thinking and critical thinking. What is the relationship between the two?

Good creative thinking involves critical thinking. So we must avoid viewing critical thinking and creative thinking as two separate patterns of thought. Sometimes in looking at a situation, the main aim is analytical appraisal. Sometimes in facing a situation, you need to produce an innovative product and this calls for creativity or creative thinking. But you shouldn't try to keep the two processes too far apart.

What Cognitive Scientists Know and Report About Thinking, Its Processes and Skills

Critical thinking and creative thinking overlap—Two main aims of critical thinking—The skills needed to carry on critical thinking—Which definition of critical thinking skills should your district adopt?—A startling definition of creative thinking—What are the sources of creativity?—What is the nature of creative thinking?—Metacognition: dimension of thinking and its uses.

Let's keep things simple before they get complex. And discussions of thinking skills instruction quickly tend to become complex as advocates of more than a score of cognitive theories present their points of view. For example, some researchers claim there are but a half a dozen basic thinking skills; others claim there are 53 thinking skills to be learned just in the seventh grade; and still others believe that it is essential to learn at least 127 skills. Similarly, some experts argue there are no such things as lower and higher order skills; that, say, memorizing, usually put down as a lower order skill, is just as important as analyzing, which has been elevated to the higher order category of thinking skills. And there are disputes, too, whether creative thinking should really be called generative thinking and whether critical thinking is the *most* abused or the *second most abused* term in use today.

Laying aside such disputes for the moment, let us begin at the beginning: The mind can be set to work for a variety of purposes and in a variety of ways. To use a shorthand phrase, let's call such workings of the mind *the processes of thinking*.

Thinking processes can be directed toward two major purposes—(1) the solution of problems and making decisions and (2) creation of products or ideas that did not exist before.

Call the first process critical thinking. Call the second process creative thinking.

Psychologists used to believe that critical thinking was a process separate and apart from creative thinking. They maintained that the creative thinker, in any enterprise, had little use for reasoning and may have been incapable of it.

New research shows, and new theories hold, that creative and critical thinking overlap and complement each other. Thus critical and creative thinkers, *both*, have a purpose in their work. They *both* seek and need to be well-informed about the requirements of their tasks. They *both* need to be open-minded, consider a number of different points of view, withhold judgment when there is insufficient information, and look for alternatives.

It is true that some individuals excel in critical thinking while others excel in creative thinking. Yet, say researchers at the McREL Regional Laboratory, Denver, "Everyone thinks critically and creatively. Every individual has the ability to, and frequently does, engage in both kinds of thinking. Critical and creative thinking may be two sides of the same coin: Each kind of thinking is important to the success of the other."

Despite the kinship of the two processes, it is useful to examine them separately.

Critical thinking has two major objectives.

- Problem solving—Our car breaks down and we have to figure out a way to get home. We lose the key to the house and we need to find a way to get inside. Or, at other levels, teachers demand a 10 percent raise and the fiscal data in the school district indicate that the funds are not readily available—What is the board to do? The process of problem solving involves reaching a specific goal, although at first we may not have either the information or the resources for reaching that goal.

- Decision making—Here the mind faces two or more competing alternatives. Should we go to Spain for our vacation or stay home and find simple ways for enjoying leisure time? Should our school district plan a program of early childhood education or use available funds to strengthen instruction in junior high? During the decision-making process, we face advantages and disadvantages of each alternatives. But act we must, unless postponing action is also a conscious decision.

Scholars identify other thinking processes such as (1) concept formation, (2) comprehension, and (3) argumentation. Textbooks on cognitive skills list additional processes, under different labels. On the other hand, some researchers maintain that virtually all forms of cognition can be described as problem solving or requiring decision making.

The fine points of each discussion need not hold us back here. They will be explored by your district curriculum workers and faculty members, by consultants you invite to your district, and by advocates of programs who seek to place their wares in your schools.

We now look briefly at the skills which problem solving or decision making (or several of the other critical thinking processes) call into play. There can be as many different lists of thinking skills as there are researchers or developers of programs for thinking skills instruction. The list developed by the Northwest Regional Educational Laboratory, Portland, Oregon, (1986) is serviceable. For one thing, the authors (Richard J. Stiggins, Evelyn Rubel, and Edys Quellmalz) relate the use of these skills directly to student learnings. The list follows:

Recall—Most school tasks require that students recognize or remember facts, definitions, concepts, rules, or principles. Recall questions require students to repeat verbatim or paraphrase information. To recall information, students need most often to rehearse or practice it, then to associate it with other related concepts.

Analysis—In this operation students divide a whole into component elements; or they search for a cause and effect relationship. Part/whole relationships and cause/effect relationships characterize knowledge and hence are essential for mastering or comprehending bodies of information.

Comparison—Here students are asked to recognize and explain similarities and differences. Comparisons may be simple, requiring attention to only one or two attributes of information; or they may be complex, requiring identification and differentiation of many attributes of facts.

Inference—Both deductive and inductive reasoning may be required to arrive at inferences. In deductive tasks, students are given a generalization and asked to recognize or explain the evidence that relates to it. In inductive tasks, students are given the evidence (or details) and asked to come up with the generalization.

Evaluation—This skill requires students to judge quality, credibility, worth, or practicality. To help them make such judgment, students are asked to set up criteria (or standards) and then explain how these criteria are or are not met.

Such, then, is a bare-bones list of critical thinking skills for development in, and with, students.

Skills and Subskills

To venture into deeper waters, let's refer to the list of thinking skills developed by Robert Marzano, McREL Regional Laboratory, Denver. In a 1986 monograph of which he is chief author, Marzano says that teaching thinking begins with teaching the student to *set a purpose*, and this, in turn, requires no less than 12 related skills or subskills. Next, we must teach the student to *gather information*, a skill that requires observing, finding new facts, recalling previous knowledge, and verifying the facts that have been gathered. Third, Marzano says we must teach students to *organize information*. Here the going gets tougher, because Marzano would have us teach the student six major skills and no less than 21 subskills.

Putting a magnifying glass, as it were, on this *one* skill of organizing information, here are six major skills and 21 subskills to be mastered, as listed by Marzano:

1. **Representing**
   1.1 Changing the form but not the value of the information
   1.2 Assigning a name or label to the information collected
   1.3 Representing information via a logic, mathematical, music,or other type of symbol
   1.4 Outlining or highlighting information
   1.5 Designing a model of the information

2. **Comparing and contrasting**
   2.1 Identifying similarities within the information gathered
   2.2 Identifying differences within the information gathered

3. **Grouping and classifying**
   3.1 Grouping and classifying information by common characteristics
   3.2 Grouping and classifying by preassigned categories
   3.3 Grouping and classifying using other criteria

4. **Ordering**
   4.1 Ordering information by sequence or position
   4.2 Ordering information by intensity
   4.3 Ordering information by duration
   4.4 Ordering information by other criteria

5. **Arranging**
   5.1 Arranging information in tables
   5.2 Arranging information in graphs
   5.3 Arranging information in diagrams or flow charts
   5.4 Arranging information in other formats or frames

6. **Storing**
   6.1 Visualizing information in various ways
   6.2 Associating information with various memory clues
   6.3 Using structured memory devices

Completing Marzano's List

Moving on with Marzano's list, without again going into detail, we come next to *analyzing information* (here we find five major skills and 23 subskills). Then on to *synthesizing and integrating*, which means putting together the information gathered from previous functions (here we find four major skills and 12 subskills). Finally, we come to *applying outcomes*. This is the point at which we reach a solution, create a product, or arrive at an answer that leads to action. Once we reach this stage, Marzano would further teach students (1) sharing the outcome with others, (2) accommodating new ideas and insights, and (3) applying the results of the critical thinking to new situations.

Note: For a full discussion of the thinking skills only briefly sketched above, see *The Dimensions of Thinking*, by Robert Marzano, and others. Address inquiries to ASCD, 125 N. West St., Alexandria, VA 22314.

Marzano's thinking skills dimensions represent an ambitious pattern; educators working directly with students are less expansive and more practical when they propose the mastery of thinking skills.

Good illustration of such practicality are the 15 critical thinking skills that California wants its students to master by the time they are in grade eight. Below are the skills measured by the California History-Social Science State Competency Test for eighth-graders. Note the three categories of thinking behavior that form the foundation of the test.

1. **Defining and clarifying the problem**
   - Identify central issues or problems
   - Compare similarities and differences
   - Determine which information is relevant
   - Formulate appropriate questions
   - Express problems clearly and concisely

2. **Judging information related to the problem**
   - Distinguish among fact, opinion, and reasoned judgment
   - Check consistency
   - Identify unstated assumptions
   - Recognize stereotypes and cliches
   - Recognize bias, emotional factors, propaganda, and semantic slanting
   - Recognize value orientations and ideologies

3. **Solving problems/drawing conclusions**
   - Recognize the adequacy of data
   - Identify reasonable alternatives
   - Test conclusions or hypotheses
   - Predict probable consequences

"Start Small. . . . Be Consistent. . . ."

Even after an intensive review of the literature on thinking skills, the administrator and district staff will still face the questions, Which list to use? Which taxonomy to adopt? The answer is that each district will have to respond in its own way, after study and discussion. But here is advice heard at study institutes sponsored by ASCD during 1985 and 1986 in Atlantic City, New Jersey; Vail, Colorado; and Alexandria, Virginia:

"Start small. Don't go for long lists of thinking skills any one of your teachers or principals can bring. Focus on 10 or 15 skills for starters. Define each of the thinking skills as clearly and as concretely as possible. Single sentence descriptions aren't very useful. Just what do you mean by, say, 'Distinguish the relevant from the irrelevant?' Attach enough detail to each skill so that teachers will know what is meant. And stick to those thinking skills which are already imbedded in your curriculum and in the textbooks which your teachers use in the several disciplines."

Another, even shorter piece of advice, comes from the Northwest Regional Educational Laboratory, in the document *Measuring Thinking Skills in the Classroom:* "The key to success in teaching and measuring thinking skills is to adopt a taxonomy of skills on which teachers and administrators can agree—and to use that list of skills consistently."

Examining Creative Thinking

The practical-minded administrator may be startled by this definition of creativity: "Creativity [is an] arbitrary harmony, an expected astonishment, a habitual revelation, a familiar surprise, a generous selfishment, an unexpected certainty, a formidable stubbornness, a vital triviality, a disciplined freedom, an intoxicating steadiness, a repeated initiation, a difficult delight, a predictable gamble, a miraculous expectation, and accustomed amazement. . . ."

For all its poetic fancifulness, the definition was offered by a serious investigator (Prince, 1970) and suggests the potentials of creative thinking.

From a corps of hard-headed investigators in creative thinking, come these conclusions about the topic:

- The notion that creative thinking comes as a result of effortless inspiration and spontaneity has little basis in fact. The preconditions for creativity in thinking are precise and prolonged grappling with an issue—Thomas Edison's statement that genius is 99 percent perspiration and 1 percent inspiration is a scientific truth.
- Creative thinking is no easy-chair activity. It involves pushing one's ability to one's limits of performance. Researchers put it this way: Thinking creatively requires working at the edge rather than at the center of one's capacity. This drive to push to the limits of one's performance calls for risk taking and departures from accepted norms.
- Creative thinking requires self-confidence, a trust in one's own standards and criteria. Creative thinkers look inwardly to themselves rather than outwardly to others for judgment and approval. Quite frequently the creative thinker wants to work alone, so as to have a buffer zone from customary norms and practices.
- Creative thinking is "flexible," "divergent," or involves seeing things (as Edward deBono would put it) laterally, from all sides. These terms imply that we must not be boxed in with regard to our perceptions of how things work, or may work, if we are to develop new products or innovative ideas. Creative persons look at a problem or challenge from many different vantage points—they continually shift points of view to obtain new perspectives.
- Creative thinking permits the subconscious to come to the surface. There are many examples in history testifying to the role of the subconscious in creative work: Coleridge's sudden awakening to write the magic fragment starting "In Xanadu did Kublai Kahn . . ."; Mendelev's report of seeing the periodic table of elements in a dream; Kekule's vision in broad daylight of molecular structure. However, the bulk of the scientific evidence is that the subconscious will assist in creative work only if the conscious mind is already at work on the problem. The creative thinker doesn't simply sit back and wait passively for solutions or products to appear. Hard, conscious work, plus the workings of the subconscious, often bring brilliant results.

Creativity in Schools

The interest of educators in creative thinking goes back more than a half century and reached a high point with the work of E. Paul Torrance in the 1960s.

Torrance, now a professor at the University of Minnesota, focused on how the environment can foster creative learning. He maintained that the school environment must allow students to be curious and to feel comfortable in attempting difficult tasks.

For Torrance, creative thinking results in a product of novelty. Thinking for creative ends requires a modification or rejection of previously accepted ideas. The creative problem-solver follows a series of steps, which, according to Torrance, are as follows:

1. Become aware of the problem
2. Bring together available information
3. Define the difficulty of solving the problem
4. Search for solutions by making guesses
5. Formulate hypotheses
6. Test and retest each hypothesis
7. Perfect a final hypothesis
8. Communicate results.

Much of Torrance's work was with gifted students. He and his associates spent a great deal of time in classrooms conducting lessons from which they derived conclusions about learning. One such lesson asked groups of students to determine the contents of a box without opening it. Students explored the box and its contents by moving it around and investigating it for smell and sound. After intensively examining the box, students generated hypotheses, verified the accuracy of their hypotheses by asking questions, and altered their hypotheses as to the contents of the box.

Torrance emerged in the 1960s and 1970s as a major influence on the design of programs for gifted students. During the 1980s educators are applying his ideas to the broader student population.

Another creative thinking leader who has had a significant impact upon the creative thinking movement is Edward deBono. DeBono identifies two processes: lateral thinking and vertical thinking. Through lateral thinking the individual generates ideas and solutions to problems which are

A Comparison

The nature of critical thinking—	The nature of creative thinking—
• Is purposeful and dominated by goals	• Involves taking risks
• Is reasonable, reflective, and focuses on deciding what to believe and what to do	• Calls for continual recasting of ideas—creative thinkers are flexible in their approach to their tasks
• Involves comparing and contrasting information with standards or criteria	• Involves intense desire and preparation, but uses flashes of insight from the subconscious

A CONCEPTUAL FRAMEWORK OF THINKING SKILLS

METACOGNITION

PROBLEM SOLVING

DECISION MAKING

CRITICAL
THINKING

CREATIVITY

BASIC REASONING OR THINKING SKILLS

verified through logic, or vertical thinking. DeBono maintains that the ideas or solutions generated during lateral thinking may be original creations or may be new ways of looking at something that already exists.

One example of a deBono thinking strategy is called PMI. In this exercise, students generate three types of information: Plus Points (P), Minus Points (M), and Interesting Points (I). From these lists, students gain a broader and deeper insight into the problem to be solved. According to deBono, the PMI system prevents the individual from rejecting a potentially valuable idea that seems unworthy at first sight. In addition, the individual is more likely to see possible disadvantages to an idea that seems initially appealing.

William J. Gordon is a third major influence on creative thinking. Thirty years ago Gordon began studying creative associations in his Harvard University laboratory. From this study, Gordon came to understand that innovations are the result of a connection-making explosion. "The Schick injector razor was invented by an army man who perceived an analogy between loading a repeating rifle and loading a razor," Gordon has said.

Gordon believes that everyone has creative abilities and that students can be taught to improve their creative efforts by making a connection between the new and the familiar. The army man already understood the functioning of the repeating rifle. This familiarity served as a stimulus for understanding the concept of loading a razor.

Gordon has called his approach to creativity *synectics*.

Message from research

Students who are aware that higher-level thinking skills are being taught will be more likely to practice these thinking skills. The authors found that students responded in greater depth when they perceived that their teachers emphasized the thinking skills during classroom instruction.

Source: J. Houtz and R. Denmark, "Student Perceptions of Cognitive Classroom Structure and Development of Creative Thinking and Problem-Solving Skills," *Educational Research Quarterly*, 1983.

Busiest Buzz Word Afloat—Metacognition

Metacognition is neither a thinking process nor a thinking skill. It is an attitude, a point of view, a way of being aware that a person is thinking. The fact that the Greek word "meta" may mean "after," "along with," "beyond," "among," and "behind," suggests that defining metacognition is not simple.

Here, however, *is* a definition: Metacognition refers to individuals' awareness of their own cognitive performance and the use of that awareness in altering their thinking behavior.

Not all individuals are aware on all occasions when they are engaged in thinking. We say we're dreaming, or talking to ourselves, or drawing doodles in the mind. Research in metacognition tells us that such activity is thinking. Once we become aware that we think with (1) words and with (2) images, or (3) with both symbols, we can get a handle on our thinking processes.

With an awareness that we are engaging in thinking, we can decide our attitude toward the process. We can approach the process with the attitude that the task isn't really worth spending time on. Or, we can take the stance that since our mind is at work (possibly on a problem), we might just as well give it all we can. This recognition that we can succeed or fail in our thinking is an important aspect of putting our mind to work on problems.

Knowing that our mind is engaged in thinking can lead us to productive techniques. Thus, we can begin to plan specifically for the achievement of a solution or product; we can monitor ourselves, watching to see whether we have enough information or resources to keep our thinking productive; we can check on the progress of our thinking activity; we can revise our approach and try a new tack. Planning, monitoring, evaluating, and revising are important phases of metacognition. And each of these phases can be taught; or, to put it another way, we can help students engage in these metacognitive behaviors for productive results. In short, metacognition refers to a thinker's awareness of whether a current approach to problem solving is working.

Serviceable Findings

Researchers have discovered what they call serviceable information as they studied metacognition:

1. When teachers emphasize metacognitive attitudes, they convey the message to students that they must take an active role in their own learning.
2. When students "think aloud" about their problems, they improve their chances for solution or for reaching positive results. Think aloud techniques are now being tested by investigators for use in primary grades.
3. Students working in pairs have shown greater success than students working alone. In experiments conducted by Arthur Whimbey, expert in cognitive sciences, one student is designated as the problem-solver, the other as the listener. The function of the listener is to check for accuracy and to demand that the problem-solver stay on the beam by talking about the problem.
4. What does it take to be successful in the solution of complex problems in school, business, or administration? Ability? Competence? The help of others? Luck? Success may depend upon all of these factors. However, research on metacognition problems reports a clear answer. It is effort—intense, extended effort—that leads to success more than any of the other factors. Stick-to-it-iveness is a principle of metacognition.

7 PROGRAMS AND PACKAGES

Searching for the Right Thinking Program: Considerations—and Points for Decision

The case for the district-developed thinking skills program—And the case against it—Should instruction in thinking be a separate course or should it be part of the curriculum?—*Caveat emptor:* what to do before buying a program—Advantages and disadvantages of programs from commercial sources and those developed locally—A sampling of programs you can buy and what they seek to achieve.

When a school district becomes serious about introducing or expanding a thinking skills program for its students, officials face a prime question: Shall we develop our own program or go to the marketplace to see what is available for purchase?

The case for and against a program developed by the district, for the district, is easily stated. By developing your own program, you'll get exactly what you want; or, if not exactly, as close to what you want as possible, depending on what you can afford to put into its development. The process of development, if kept on home ground, may involve many staff members—teachers, curriculum workers, principals, and other administrators. Interest and effort will intermingle. A long and intensive learning experience will engage the district. In the end—if you should achieve an acceptable product—your staff will be able to say: This is ours. We did it ourselves.

But all that is quixotic, say those who state the case against a district venturing to develop its own program. They often say that only the largest and most affluent districts should even think about taking that approach. Among the first requisites are staff members with specialized knowledge in cognitive sciences to lead the way. In addition, the district experts will have to be of the highest order if they are to develop a theory and rationale for the district thinking program. These local experts must be able to work out teaching procedures and lesson plans for thinking skills development. No small challenge, too, is producing the inservice materials for the program's implementation, and, finally, finding ways to evaluate it.

"It's a lifetime work," said one cognitive scientist. "It has taken Reuven Feuerstein four decades and a team of psychologists working with him to bring his Instrumental Enrichment program to its present stage." Similarly, the developers of Philosophy for Children or the CoRT creative thinking program have devoted their entire careers to a single project.

Observers of the thinking movement have pointed out that districts trying to develop their own programs usually borrow heavily from those in the market—and only in rare instances achieve a unique piece of work.

Districts Venture, Some Succeed

Nevertheless, districts do venture, and either in limited or comprehensive ways work out thinking skills programs that suit their needs. Take note, for example, of such sophisticated school district programs as those from Orange County, California, (IMPACT); from Peotone, Illinois, (Early Prevention of School Failure); and Shoreham Wading-River Central School District, Shoreham, New York (Cognitive Level Matching).

City districts—Cincinnati, Pittsburgh, and Dallas, for example—have done quite well in molding their own programs; as have such medium-sized districts as Evansville, Indiana; McMinnville, Oregon; and Manitowoc, Wisconsin.

And even smaller districts provide critical thinking units in selected subject-matter offerings. Chicago Heights, Illinois, for example, with about 4,000 students, is one of several hundred districts which report that they do not have an overall thinking skills program now, but, "We are thinking about it and hope to make that a goal next year." However, Chicago Heights has made a modest beginning. "We have introduced a critical thinking unit in English I," writes a spokeswoman for the school system. The unit follows sound cognitive science, having as its aim to help students differentiate between fact and fiction, the abstract and the concrete, the specific and general, appeals to emotions, and to draw justifiable inferences from specified information. In addition, Chicago Heights makes available a nine-week course in critical thinking to juniors and seniors taking elective courses in literature, including fiction and nonfiction.

Chapter 8, "Districts Report Their Experiences," and the items listed in the box (page 44) titled "From School Districts—Materials on Thinking Skills" attest to the enterprise of districts in developing thinking skills programs and materials.

The activity in local districts needs to be viewed with two facts in mind: First, it represents but a small number of districts, since more than 80 percent of superintendents who responded to the AASA survey reported they do not have any program of any kind—either acquired from commercial course or developed by district staff. Second, district efforts in developing their own thinking programs will rise sharply during the next few years. The reasons for this upcoming trend are significant. Some school administrators are not entirely enamoured of the commercially available programs and are laying plans for locally developed programs. Like Superintendent William Streich, of Farmington, Connecticut (see page 62), many administrators are becoming convinced that only a thinking skills program geared to their own curriculum will satisfy their needs.

Separate or Infused?

Here, then, we come to the second decision facing administrators—whether to support a course or courses in thinking separate from content, or whether to infuse thinking skills into all subject matter, or both.

As we have seen on page 11, some school administrators strongly oppose separate courses devoted to thinking skills. The unwillingness of teachers to accept "still another course," and the primacy of content in the minds of parents are probably two major reasons for this belief.

It is no accident that the American Federation of Teachers' thinking project is based on the principle of "no separate course in thinking." Such a view is a reflection of widespread teacher attitudes, in AFT and out.

Some cognitive scientists do not agree with the no-separate-course dictum. They say that separate courses in thinking skills can do exactly what teachers, administrators, and the public want schools to do—help students learn *all* subject matter more effectively. They point to such programs as Structure of Intelligence (SCI), Instrumental Enrichment, and Philosophy for Children—all separate courses—which claim that they promote the cause of content mastery, directly or indirectly.

Before the Search Begins

Having made these two preliminary decisions, is the administrative staff ready to see what products and services cognitive scientists have to offer the schools? Not necessarily. Before venturing into the marketplace there are questions to be answered and actions to be taken.

An essential step is to assess the advantages and disadvantages of commercially-promoted programs, especially in relation to those developed locally by district staff.

The point has been made already that the commercially promoted program is sometimes a work of cognitive sophistication, a product of long research by renowned specialists. When buying such a program you buy a package of lessons and also inservice education and evaluation procedures and materials. You know exactly what the program promises—and almost always delivers.

Now we come to some concerns. Barry Beyer has pointed to some of these in his talks and articles. He says: "If we adopt, or adapt, one of the existing programs from commercial sources, we run the risk of absolving a lot of teachers from thinking themselves. Some of the programs are so well put together that the teacher doesn't have to think."

His most serious charge against the commercial programs is that they sometimes operate in "a subject-matter free context." The programs use content from the life experiences of students, from random samples of writings, from stories children may like—but *not* from the subject matter content offered in schools. This approach pleases neither teachers nor administrators. (See box "The Plus and the Minus," page 43.)

Then come these questions:

- Are teachers and curriculum workers ready and willing to discuss the acquisition of a thinking program?
- Does the board of education understand the rationale for introducing thinking skills into the curriculum?
- Has a board policy on thinking skills been thoroughly discussed (by teachers, administrators, and the public) and approved by the board?
- What particular thinking skills does the district believe to be of first importance to teach?
- What financial resources does the district have for (1) carrying on preliminary investigations and hiring consultants to advise on steps and procedures; and for (2) outlays to purchase a program, its products, and services.
- Is the district prepared to take on the inservice activities that a thinking skills program requires?
- Does the district plan to experiment with limited approaches and with a pilot program?

"Clearly, the decision on which program to use should be made only after extensive deliberation and outside consultation, preferably with people who have expertise but not a vested interest in the implementation of one particular program or another," says Robert J. Sternberg, Yale University.

What's Available for Acquisition?

Before you begin examining in earnest the products and services that cognitive scientists offer school districts, do your homework. Look into at least two guidebooks that list and describe the major "intervention programs" for teaching students intellectual skills. The first is *Developing Minds, A Resource Book for Teaching Thinking,* edited by Arthur L. Costa (published by ASCD, 1985; price $19.95). Part VIII of this book lists and describes 16 programs for teaching thinking. The second useful handbook for homework is *Teaching Thinking,* by Raymond Nickerson, David Perkins, and Howard Smith (published by Academic Press, New York, 1985) which reviews available programs for training in thinking skills.

What is available can be grouped under three major categories. Below we list and describe a couple of programs under each category, cautioning that many more programs could be listed and that the items are cited for illustrative purposes only, without any intent of endorsement.

1. Programs with the primary focus of improving the learner's ability to learn. Two examples are:

Structure of Intellect (SOI) is based on J. P. Guilford's theory of intelligence, first applied in 1962. Although originally used with the gifted, SOI is now accepted as a program for all students who have a need to improve their skills in reasoning and in applying some 90 kinds of thinking skills necessary for successful learning.

Mary N. Meeker, who has worked closely with SOI for more than two decades, says that "SOI allows us to start even our youngest students on the ladder of developing higher-level reasoning and critical thinking abilities." She claims further that "the greatest payoff is increased academic achievement as measured by standardized tests."

SOI is a complex package. It calls for training teachers in diagnostic procedures. At the minimum, a two-day staff development seminar is required to lay the foundation for its use.

Instrumental Enrichment (IE) is Reuven Feuerstein's cluster of problem-solving tasks and exercises, described as "a direct and focused attack on those mental processes which through absence, fragility, or inefficiency are to blame for poor intellectual or academic performance."

IE provides materials and instruments for one-period lessons, scheduled for two to five days a week. Its authors recommend a three-year sequence, but suggest that two may be sufficient. IE sponsors assure administrators and teachers that "the program is not intended to replace traditional content areas, but will help students get the most out of all opportunities to learn and grow, and make bridges to all subject matter areas."

The program requires a minimum of 45 hours of inservice training, according to Feuerstein.

2. Programs that seek to enhance formal reasoning skills of children. Examples:

Philosophy for Children, developed by Matthew Lipman, aims to promote students' ability to think about principles, or in the words of the developer, "to improve children's reasoning ability as they discuss concepts of importance to them."

Among concepts the students encounter and work with are truth, beauty, fairness, justice, freedom, authority, education and other social institutions.

Under teacher-guided discussion plans, students make inferences, draw analogies, form hypotheses, and practice classification.

Philosophy for Children requires about two and one-quarter hours a week for a full school year; it is not unusual for the program to extend over two years, since much class time must be devoted to discussions and exercises.

"Not every teacher is cut out to teach *Philosophy for Children*," says Lipman. Training in the use of the curriculum materials is indispensable, and inservice activities may stretch over two years.

Critical Thinking is the creation of Anita Harnadek and is designed for secondary school students. The package consists of Book 1 and Book 2, published by Midwest Publications (P.O. Box 448, Pacific Grove, CA 93950), a publisher that specializes in thinking skills materials.

Books 1 and 2 include chapters on elements of logic, common errors in reasoning, propaganda techniques, probabilities of truth and falsity, learning to be open-minded. The program provides more than 2,000 problems for discussion—and class discussion is the basis for instruction in the Harnadek program.

While *Critical Thinking* concentrates on formal logic, its basic premise is that thinking skills learned can be transferred to English, social studies, and mathematics. The degree to which this transfer is achieved is subject to debate. However, the program has been assessed by the Watson-Glazer Test of Critical Thinking and the Cornell Test of Critical Thinking and has received favorable recognition.

3. Programs that seek to promote creative thinking.

CoRT is a product of Edward DeBono, promoted through his Cognitive Research Trust and published by Pergamon Press, Elmsford, New York. Insisting that "critical thinking is not enough," deBono offers a 60-lesson set in "lateral" thinking, a label for thinking not governed by rigid steps or linear sequence ("First we do this, next we do this, then we . . . ," etc.). DeBono teaches that in solving a problem, we should "step aside," look at it from a number of different angles, and dare to welcome a variety of ideas.

CoRT requires one 15-minute lesson a week for three years. Its audience may range from students in the early grades to adults, and from all ability levels.

While some educators swear by the program, others say it is more useful for adults, for industry, and for administrators than for students. They make the point that CoRT is primarily a program that increases decision making, rather than enhances academic studies.

More closely geared to curriculum are the creative thinking programs from (1) ***Institute for Creative Education*** (ICE), based in Sewell, New Jersey, and (2) ***Talents Unlimited*** (TU), originating in Mobile, Alabama.

ICE aims to develop in K to 12 students fluency in thinking, flexibility, and originality. It offers instruction in creative thinking embedded in content. "ICE does not involve the teaching of social studies creatively; rather it involves the teaching of creative thinking using the content of social studies to do it," says one observer. Student exercises offered include the use of analogy, brainstorming, and meditation.

TU is also content-oriented and aimed at elementary school students of all ability levels. Among the skills TU is concerned with are planning, forecasting, and decision making—all related to academic subjects.

Other Aims, Other Programs

Also available for acquisition are programs with aims more limited than teaching students how to learn, or how to think and reason critically, or how to think creatively. Educators who want programs that (1) seek to integrate thinking skills into content areas, (2) offer direct instruction in a narrow band of skills that underlie a single area of the curriculum, or that (3) are geared to Piaget's ideas of teaching have many to choose from. The box on pages 41–42 lists the options.

Programs for Your Choosing

—a few examples out of many programs that have been evaluated by the National Diffusion Network.

1. For integrating thinking skills into content areas:

PROGRAM	**COMMENT**
Project Impact, by Lee Winocur. Publisher: Orange County Schools, P.O. Box 9050, Costa Mesa, CA 92626	Focus is on classifying and categorizing, ordering and sequencing ideas, recognizing patterns and relationships, recognizing fact and opinion, identifying relevant and irrelevant information, effective questioning, seeking cause and effect relationships, making generalizations, forming predictions, and making assumptions. Designed for junior and senior high school students. Lessons include direct instruction activities for students and lesson plans for teachers.
Learning To Learn, by Marcia Heiman. Publisher: Marcia Heiman, Box 493, Cambridge, MA 02138	Focus is on raising and testing hypotheses and breaking complex ideas into manageable parts. Includes series of learning strategies to help students think actively while engaged in content learning. Designed for junior high school through college.

2. For direct instruction in a band of thinking skills underlying elementary and secondary school offerings:

PROGRAM	**COMMENT**
Building Thinking Skills, by Sandra and Howard Black. Publisher: Midwest Publications, P.O. Box 448, Pacific Grove, CA 93950	A series of books for middle elementary, upper elementary, and junior high school levels. Among objectives are to develop student ability to recognize similarities and differences in content areas; to sequence facts; to classify facts and data; and to make analogies. Black and Black based their program on Bloom's classic taxonomy.
Think Program. Publisher: Innovative Sciences, Park Square Station, P.O. Box 15129, Stamford, CT 06901	Emphasizes the skill of perceiving relationships. The focus is on thing making, qualifications of words and ideas, classification and grouping, analysis of the whole into parts, and analogy. Includes media kits and student workbooks. Designed for elementary through high school.

3. For infusing thinking skills in school offering, using Piagetian methods:

Early Prevention of School Failure, by Lucille Warner. Publisher: Peotone School District 207-U, 114 North Second St., Peotone, IL 60468	Objectives focus on gross and fine motor development, visual and auditory discrimination and language skills. Includes diagnostic and prescriptive activities, with screening instruments, management guides, classroom activities, and parent materials. Designed for students 4 to 6 years of age.

PROGRAM	**COMMENT**
British Primary Schools Nuffield Mathematics. Publisher: John Wiley, New York, N.Y.	Includes teacher directions for conducting and organizing science and mathematics instruction. Designed for students 5 to 13 years of age.
Alpha II Program Publisher: Alpha II, 2425 Alamo SE, Albuquerque, NM 87106	Materials focus on conservation, classification, seriation, number and space perception. Program uses manipulatives, lesson cards, a management plan, and questioning strategies.
Comprehensive School Mathematics, by Claire Heidema. Publisher: Claire Heidema, 470 N. Kirkwood, St. Louis, MO 63122	The focus is on classification, elementary logic and number theory. This program is experiential. A pre- and post-assessment instrument has been prepared by developer.
Cognitive Level Matching Project, by Martin Brooks. Publisher: Martin Brooks, Shoreham Wading-River, Central School District, Shoreham, NY 11786	Uses instructional methods appropriate to students' intellectual development, as defined by Piaget. Materials provide extensive staff development opportunities in recognizing and integrating Piagetian methods. Program is used for K–12 academic subjects.

Get to Know The Best

As new programs in teaching thinking skills become available from commercial and district sources, they are evaluated for effectiveness by the Joint Development Review Panel (J.D.R.P.) and results are available to school district administrators through state facilitators of the National Diffusion Network. For information, write the National Diffusion Network, U.S. Department of Education, 1200 19th St., N.W., Washington, DC 20036.

The Plus and the Minus

Have you and your staff explored the advantages and disadvantages of an acquired thinking skills program against the advantages and disadvantages of one developed within the district by your own staff? Here are starting points for consideration.

Programs Acquired from Commercial Sources

Advantages	**Disadvantages**
1. Wide choice. The market offers programs with different definitions of cognitive skills, different objectives and methodologies.	1. May be unrelated to local curriculum and content.
2. Based on sound theory of cognition. Extensive research by experts is usually behind program.	2. Perceived as "another course" to be taught. Teacher acceptance might be hard to develop.
3. Lesson plans and instructional materials are on hand.	3. Implies that thinking can be taught in prescribed number of lessons in a given number of semesters.
4. Inservice materials and procedures come with the program.	4. Programs may absolve the teacher from thinking—"because the materials do the job. . . ."
5. Instruments for evaluation are available and identified.	5. Specifications for inservice may be burdensome for district.

Locally Developed Programs

Advantages	**Disadvantages**
1. A participatory project. District teachers, curriculum workers, and administrators involved in development.	1. Process of development may be long—possibly years—and costly.
2. Final product acclaimed as "Ours!" by district teachers.	2. Requires experts in cognitive knowledge for development.
3. Final product geared to local curriculum and content.	3. Requires the creation of a theory of cognition and identification of thinking skills to be taught.
4. High degree of acceptance and use by classroom teachers.	4. Developing evaluation instruments is major undertaking.
5. Program can be revised as local circumstances require.	5. Production of inservice materials for program may constitute an obstacle.

From School Districts—Materials on Thinking Skills

Part 1:
For all students

Communication Arts Problem-Solving Packet, Princeton City School District, 25 Sharon Rd., Cincinnati, OH 45246. Problem-solving approach to teaching language arts and enhancing thinking skills; K–6. Contact: Shirley Henderson.

Critical and Creative Reading. Evansville-Vanderburgh Schools, 1 Southeast North St., Evansville, IN 47708. Workbook with stories, fables, illustrations, advertisements which provide base for lessons on such topics as propaganda and product design; grade 8. Contact: Bob Morgan.

Critical Thinking in English. Bloom Township High School, 6th St. and Dixie Highway, Chicago Heights, IL 60411. Thinking exercises using signs (symbols have meaning), cause-effect, and analogy, grade 9. Contact: Nancy Larner.

Horizons Primary Academy. Evansville-Vanderburgh Schools, 1 Southeast Ninth St., Evansville, IN 47708. Lessons developing problem-solving skills, including use of analogy; primary grades. Contact: Bob Morgan.

Integrating Reasoning Skills in a District's Instructional Programs. Valley Educational Consortium (VEC), 800 East 2nd St., McMinnville, OR 97128. Techniques for teaching reasoning skills. Contact: MaryAnn Escott.

Thinking. Honolulu District, 4967 Kilauea Ave., Honolulu, HI 96816. Pamphlet providing overview of types of thinking skills; gives examples. Contact: Margaret Donovan.

Thinking Curriculum. Manitowoc Public Schools, P.O. Box 605, Manitowoc, WI 54220. Discusses types of thinking: brainstorming, fluency, flexibility, originality, elaboration, curiosity, risk taking, imagination, complexity, creative problem solving; sample activities offered for developing each type.

Part II—
For gifted and talented

Above and Beyond. Montgomery County Public Schools, 850 Hungerford Dr., Rockville, MD 20850. Annotated list of materials for teaching higher-order thinking skills; K–12. Contact: Renee Brimfield.

Challenge: A Handbook for Gifted and Talented and Higher Achievers. East Ramapo Central School District, 50-A So. Main St., Spring Valley, NY 10977. A system for integrating thinking skills into all subject areas; also useful for classes of average ability; K–12. Contact: Diane Gess.

Creative Learning Applied to Specific Strengths (C.L.A.S.S.). Kenmore-Town of Tonawanda Union Free School District, 1500 Colvin Blvd., Kenmore, NY 14223. Model enrichment program applicable to all content areas, with sample activities; K–8. Contact: Robert Freeland.

The Gate Handbook. East Ramapo Central School District, 50-A So. Main St., Spring Valley, NY 10977. Explanation of theory and practice of problem solving, with problem-solving activities; K–12. Contact: Diane Gess.

Interdisciplinary Guide for Gifted and Talented, K–3. Montgomery County Public Schools, 850 Hungerford Dr., Rockville, MD 20850. Focuses on six teaching strategies for developing thinking: research process, research skills, webbing, brainstorming, synectics, questioning. Contact: Renee Brimfield.

Interdisciplinary Guide for Gifted and Talented, Middle Grades and Junior High School. Montgomery County Public Schools, 850 Hungerford Dr., Rockville, MD 20850. Covers theory into practice for teaching thinking skills, with units emphasizing comparing and contrasting, controlling variables, drawing inferences, and other skills. Contact: Renee Brimfield.

Language Arts Enrichment Program. East Syracuse-Minoa Central Schools, 407 Fremont Rd., East Syracuse, NY 13057. Problem-solving units, some math-oriented, that get into brainstorming, conceptualizing, hypothesizing, "imagineering," speculating, and risk taking; K–8. Contact: Starr Canestraro.

Mini-Interview with Robert J. Sternberg, Yale University

Robert J. Sternberg, professor of psychology, Yale University, is a leading researcher and author in thinking. His work on intelligence and training students to use higher order skills has had a strong impact on the thinking movement. Sternberg responds to three questions of interest to administrators.

What are the advantages and disadvantages of teaching thinking as part of content instruction?

We call the teaching of thinking during content instruction "infusion." With infusion, you don't have a separate thinking course. You teach it as part of social studies, science, mathematics, English, and other subjects. The advantage of infusion is that you have students "thinking about thinking" in the context of their school experiences. Thinking is not isolated. A second advantage is that infusion does not require a separate thinking skills program. A third advantage is that infusion makes it clear that thinking is not perceived by the student as separate from daily life.

On the other hand, there are disadvantages to infusion. One problem with infusion is that it doesn't always work with all teachers. I've seen some teachers try to teach thinking skills during content instruction and it didn't work for them. The teachers were too dogmatic; they were too dictatorial; the idea of discussion was foreign to them. If infusion is done badly, you are better off to avoid it. A second problem with infusion is that teachers are usually held accountable for the quantity of subject matter. Since the bottom line is how much the students are learning in terms of facts, the thinking skills tend to get lost.

A good many administrators are willing to let teachers go ahead "on their own" with thinking skills instruction. Why should administrators get involved at all?

Unless the administration supports the thinking skills program, the school district should not even get into it. Based on my work in many schools, I've seen cases of enthusiastic teachers undermined by lack of administration support. The administration must avoid sending this message to the teacher: "Thinking instruction is just something that is fine if you want to do it." The administration must provide support for teacher training and for released time so that teachers can learn from experts and each other. If you want teachers to incorporate thinking into instruction, you have to provide them with the opportunity for learning how this instruction should be done.

What is the biggest problem related to thinking instruction that you have observed?

The biggest problem is that most school districts show a tremendous amount of interest without follow through. It is much easier to have workshops than to actually implement a program. It is much easier to listen than to implement. The proof of the pudding is in the tasting and not just in talking about it. Follow-through is the biggest problem.

Districts Report Their Experiences in Promoting Thinking Skills Instruction

A dossier of reports from districts large, middle-sized, and small: Pittsburgh—Shoreham-Wading River Central School District, New York—Portland, Maine—Cherry Creek, Colorado—Fort Madison, Iowa—Manitowoc, Wisconsin—San Jose—Baltimore—Provincetown, Massachusetts—Dubois, Wyoming—Detroit—Dallas.

Pittsburgh Public Schools
Pittsburgh Pennsylvania

How this district uses its famed MAP tests to foster thinking skills

"If young people are to cope effectively in the 'information society' of the 21st century, they must be skilled at critical thinking and problem solving," says Pittsburgh's Superintendent Richard Wallace, Jr. Recognizing the responsibility that school districts bear to educate productive citizens of the future, Pittsburgh began an analysis several years ago of how educational practice was affecting thinking and problem solving skills. From this analysis, district personnel drew three conclusions:

- Although students learn to read a wide range of material, they develop few skills for critical examination of what they read.
- While schools have been reasonably successful in teaching the majority of students to comprehend what they read at a basic level, they have failed to teach more than 10 percent of students to reflect and think critically about their reading.
- Students are generally unable to respond effectively when requested to explain or defend a point of view that requires them to reexamine what they have read.

"Simply put, students have not learned the critical thinking skills that would allow them to analyze textual material and then write a coherent statement where they use evidence from their reading to support their interpretations and judgments," states Wallace.

As a result of the analysis of existing educational practice, Pittsburgh has developed a thinking skills program which is designed first to diagnose systematically student thinking skills; and second, to develop instructional techniques that improve the quality of thinking instruction.

The Diagnosis of Student Thinking Skills

Teachers in Pittsburgh are the prime diagnosticians of student thinking skills development. And they have learned to use test results as a foundation for improving thinking.

How did this come about? During 1982 and 1983, teachers and administrators worked with educational testing specialists to develop tools that would diagnose student thinking. From this effort came diagnostic assessment instruments for students in grades 5, 8, and 11.

The tests, called Monitoring Achievement in Pittsburgh (MAP), diagnose student ability to summarize, classify, infer, and evaluate. The MAP tests ask students to write an essay that addresses a particular topic. Student essays are evaluated for the critical thinking skills reflected in the writing. Teachers use a predetermined list of criteria in evaluating the student's work. Criteria cover topic sentences, evidence, explanation, conclusions, and logical organization.

Teachers both administer and score the tests. After tests are scored, teachers confer with students to discuss thinking skills demonstrated in the essays. The conference is usually a time for students to learn how they might have applied thinking skills differently. Following the conference, the students are given the opportunity to revise their papers.

The MAP test is administered over a two-day period in order to allow students adequate time to plan and revise. As the testing guide states, "Well-reasoned essays are seldom the result of a single first draft, and even professional writers need time to plan and revise."

MAP critical thinking tests are now being given three times a year to students of grades 3 through 11 in conjunction with social studies. Teachers and administrators continually provide test designers with feedback to improve the utility of MAP further.

Below are three sample MAP essay tests. Each requires the student to read background or resource material and then to construct a composition reflecting critical thinking skills. Here is what the students may confront during examination time:

1.

Directions: You have read the interview with James Otis. Now write a composition that contrasts the opinions of the interviewer and of James Otis on the use or misuse of search warrants. Your composition should include the following:

- A topic statement that tells how the two opinions differ
- Evidence from the passage to support your topic statement
- Explanations of how the evidence shows the differences of opinion
- A concluding statement pulling together what you have written.

2.

Directions: You have read the article by Thomas Paine, and you have decided whether or not his arguments have convinced you to support the fight for independence from Britain. Now write a composition in which you explain your decision. Your composition should include the following:

- A topic statement telling whether or not you would support the fight for independence
- Evidence from the article to support your main idea
- Explanations of why the evidence supports your decision
- A concluding statement pulling together what you have just written.

3.

Directions: You have read the story about an Amish child's school day. Now write a composition telling how that day is different from an average school day in your own life. Your composition should include the following:

- A topic statement that tells the main differences between the two days
- Evidence from the story and from your own life to support your topic statement
- Explanations of how the Amish child's school day is different from your school day
- A concluding statement based upon what you have written.

Instructional Techniques to Improve Thinking

Pittsburgh supplies teachers with a series of techniques to be used during instruction which enhance student critical thinking. The techniques are outlined in several booklets now widely used by Pittsburgh teachers.

One technique presented in a booklet deals with assignments. Teachers are discouraged from making bare-bones assignments that merely instruct the student to:

Write an essay on John Kennedy and tell whether he was a good or bad President.

Instead, teachers are advised to "flesh-out" their assignments, as shown below.

> Based on our class discussion, your reading, and your general knowledge, write an essay (at least two pages) in which you identify and explain your position on whether John Kennedy was a good or bad President. Decide which two elements about Kennedy's presidency you want to discuss (e.g., his role in foreign policy, in domestic affairs, as a politician, as a hero, etc.) and focus your essay on these elements. Be sure to include a clear topic statement of your position, appropriate evidence and explanations to support your main points, and a conclusion based on your own ideas.

A second instructional technique recommended to Pittsburgh teachers deals with using a

Cue Sheet

Critical Thinking Skill: Inferential Contrast

Text: Two Waves of Immigration

Task for Student: Point out the differences between the two waves of immigration.

Difference	**First Wave**	**Second Wave**
1. date	1865–1890	1890–1914
2. origins	northern and western Europe	southern and eastern Europe
3. religion	Protestant	Roman Catholic and Jewish
4. occupations	ambitious farmers	refugees from agricultural disasters
	skilled artisans	unskilled factory workers
5. purposes	find good land start new, prosperous life in countryside	join relatives in cities be part of rich American life
6. reception	welcomed in US language and customs fit in easily	not welcomed in US language and customs were very different

cue sheet to help evaluate and grade a student's skill in organizing information to understand contrasting points of view. Pittsburgh authorities advise teachers to prepare cue sheets prior to making and grading major work assignments because:

> "First, a cue sheet can show you what information students can use for evidence, and you can then check to see if it is the evidence you want. A cue sheet saves you from repeatedly trying to decide whether a particular piece of evidence is or is not appropriate or sufficient. (In creating a cue sheet, you will have identified appropriate evidence ahead of time.) Third, a cue sheet can influence your evaluation of students' responses by helping you be consistent in what you are looking for as you go from one response to another."

With the sample cue sheet below, the teacher can evaluate a student's ability to contrast historical movements, in this instance the great migrations of 1860 and 1890.

Through the instructional booklets Pittsburgh teachers continue to improve their abilities to teach thinking skills during daily classes. The effectiveness of these booklets has been increased through an extensive teacher training effort. Training includes videotaped demonstrations of critical thinking skills based on sample lessons.

Shoreham-Wading River
Central School District
Shoreham, New York

From the ideas of Piaget come strategies for teaching thinking skills

—By Martin Brooks, assistant superintendent for instruction

Since 1980, our district has been offering its teachers inservice opportunities to learn about the development of reasoning abilities in children and adolescents. The project is called Cognitive Levels Matching (CLM). Most of the notions to which teachers are exposed in the project emanate from the work of Piaget. To date, approximately 70 percent of our 230 teachers have voluntarily participated in it.

The CLM project has successfully generated classroom change for a number of reasons, three of which I'd like to highlight.

First, the project responds to a need within the district. For years, the winds in education have been blowing toward skills-based, achievement-driven experiences for children, and away from experiences that spark reasoning abilities. In this climate, the teacher is seen primarily as a manager of instruction. Curriculums (reading, for example) are divided into the sum of their parts (for example, 273 reading subskills in the Chicago Mastery Learning System) and delivered in a sequential, lock-step, test-teach-test manner. Thinking, by both teachers and students, holds less value to local administrators than do high achievement scores. Although forced to function in this climate, many teachers intellectually and emotionally rebel against this stagnant approach to education, and feel the need to construct dynamic experiences for students through which higher order reasoning will be fostered and valued. The CLM project, initiated jointly by teachers and administrators, responds to this need, and returns to teachers the autonomy and academic freedom required to take risks with students, make curriculum decisions and, above all, exercise their own abilities to think. It is difficult to imagine a "teaching for thinking" program succeeding in a climate in which teacher thinking isn't encouraged and valued.

Second, the project provides teachers with support for making change happen. Many staff development efforts in education are largely didactic in nature: after attending an inservice course or workshop, it is assumed—or hoped—that teachers will return to their classrooms and implement with fidelity that which they just learned. In the majority of instances, this simply does not occur! Instead, most teachers return to their classrooms with increased knowledge and enthusiasm, but with few, if any, practical strategies for translating their knowledge and enthusiasm into change. Implementation is hard work.

The CLM project has several ways of supporting teachers in making change happen. It relies on the efficacy of peer coaching as a strategy for helping teachers change their practices. Teachers in the CLM project are offered opportunities to form coaching partnerships with one or more colleagues, and are given some release-time to observe and support one another in their efforts to change. Second, the district created a half-time position for an instructional coach. This person, in a nonadministrative capacity, spends time in the classrooms of teachers who request such support. Third, the project annually brings several consultants to the district to teach CLM courses. Since these courses take place after school, the consultants spend the school day in classrooms observing and assisting teachers with teaching strategies. Fourth, in two of the district's five schools, building CLM support teams have been formed. Participating teachers in these schools meet on a regular basis as a group to discuss problems, successes, and specific CLM projects in which they have been involved. Fifth, all of the building principals in the district have participated in the project. This enables teachers and administrators to speak a common language and to focus their energies jointly on helping children develop higher order thinking.

Teachers are either paid or given inservice credit for their participation in this staff development effort. Teachers are professionals and need to be treated as such. It is inappropriate, even demeaning, to expect that teachers, who are being asked to change their practices in some way, should volunteer their time. If a district is serious about promulgating a specific change, it needs to support the commitment financially. Shoreham-Wading River annually devotes 1–2 percent of its budget to staff development.

Third, the project provides options for teachers. All participants in the project are required to take an introductory inservice course, taught primarily by district staff, through which they are introduced to child developmental theory and principles. Once teachers have completed this course, they may choose from a potpourri of options. For example, teachers may elect to take mini-courses, taught primarily by district staff, which focus either on content areas ("Piaget and Mathematics," "Frame Analysis and Literature Comprehension"), grade levels (Piaget Goes Primary), or specific child developmental issues ("Inquiry," "The Child's Point of View"). Teachers may also opt to conduct individual or group research on topics related to child development. And finally, teachers may decide to participate in a building CLM support team or develop a peer coaching partnership with other teachers.

Offering options enables teachers to identify their own development needs and determine for themselves how to meet those needs. This approach views teachers as responsible human beings, capable of making decisions about their own professional development and in control of setting an appropriate course toward that development. This stands in contrast to the all-too-common concept of staff development in which administrators predetermine teacher needs, fix one course which all teachers must follow, and prevent the very people who are to change from participating in decisions about the process of change.

Message from research

Training in formal reasoning can have a positive effect on student achievement.

A relationship seems to exist between formal reasoning ability and academic achievement. One would expect the strong relationship between reasoning and math or science, which *does* exist. However, an even stronger relationship exists between reasoning and social studies.

Source: A. Lawson, "Formal Reasoning, Achievement, and Intelligence: An Issue of Importance", *Science Education*, January 1982

Portland Public Schools
Portland, Maine

Stage by stage, the district reached the point "where thinking skills may bark, but not bite"

—By Peter R. Greer, former superintendent of schools, Portland Maine.

The Portland, Maine, Public Schools have gone through several stages as we tackled the complicated subject of thinking skills. The Portland experience may be valuable to others because of both its ordinariness and its discovery of the difficulties in bringing thinking skills to the attention of our staff.

The first stage was our determination that thinking skills were not merely another fad. The flood of evidence regarding the American student's inability to think skillfully, as well as our own observations, demanded serious attention to this problem.

The second stage was the formation of a teacher study group drawn from all grade levels and with the assignment to examine the literature and define what thinking skills were, what and who were available to assist us, and to construct a staff development plan.

The third stage was the invitation to several top-notch speakers to provide an "awareness session" to interest and persuade all staff members about the importance of thinking skills.

The fourth stage was the recognition that the cameo appearance of topnotch speakers wouldn't do. Along with that recognition came also our assumption that perhaps the teachers could teach each other on a sustained, internal basis. Was there anything to the proposition that most teachers already taught thinking skills in their classrooms? After all, teachers do ask questions of their students. In reality, there is more to thinking skills than most teachers and administrators fathom.

The fifth stage was our decision that the school system should start small, become proficient with a small piece of the large topic of thinking skills, and serendipitous outcomes in the Portland Public Schools.

At present, the principals of each of the 18 schools have adopted thinking skills as one of their building goals. This means that each principal and staff is developing a building plan focused on thinking skills. Some schools plan to share ideas and resources.

A recent (and successful) three-week Teachers Academy dealt with strands on Socratic dialogue and thinking skills; and 13 of our 18 buildings have at least one teacher representative who, through coaching, will attempt to add to each building's repertoire on thinking skills instruction.

Our district has created a new paid position called Writing/Thinking Coordinator. This person will work in a narrow and clear focus: the development of thinking skills in the K–12 curriculum in writing, reading, speaking, and listening skills.

We now have plans to introduce sustained staff development in the study of logic. Only a few teachers and administrators have taken a formal course in logic or have coupled that study with practical applications of thinking skills. We asked ourselves how on earth teachers could teach thinking skills to students, via the computer, kits, programs, or in the classroom, without a sound base in logic?

We enhanced a relationship with UNUM, a large insurance company that funded the Teachers Academy. That company is aware that if schools begin to graduate students with finely honed thinking skills, the future employers and supervisors had to be as competent also. One plan is to have the Teachers Academy run seminars on thinking skills for UNUM's employees at the time these scholars are working with teachers in the schools.

Where are the Portland Public Schools at this point? One tangible result: our staff is more fully aware of the energy, information, and self-learning that are required if we are serious about integrating thinking skills in the curriculum in effective ways. So far, there is no overall plan; no single program has been adopted. Teachers are asking difficult questions, such as "While we wrestle with thinking skills, will the principals and central office be flexible with curriculum coverage, time allotments for certain subjects, test score results, and with additional free time to plan and coach?" And our administrators believe that properly integrating thinking skills into teaching also requires staff development, curriculum revision, and a strong base in subject content.

To sum up, then, we are realistic about the challenge of incorporating thinking skills into our curriculum and instruction. We now have people and ideas in place, as well as a comfortable and workable direction to pursue. Our present stage is one in which thinking skills "will bark at us, but will not bite."

Cherry Creek Public Schools
Englewood, Colorado

A success story: the district integrates thinking skills into its curriculum

The Cherry Creek schools have spent considerable time and energy developing a program that integrates thinking skills into the existing curricula at all grade levels. Donald Goe, assistant superintendent, recognized the need to create an academic program that did more than teach the facts. "We, in Cherry Creek, seem to be doing a good job of teaching facts, but, as in other districts, we need to do more in the areas of reasoning and problem solving," Goe stated.

Or, as Jean Capillupo, coordinator of thinking skills instruction, has put it:

> The factual approach to learning is a very limited approach; students need to understand broad concepts to solve problems and adapt to a rapidly changing world.

The success of the thinking program at Cherry Creek is the result of an intensive effort of the Thinking Skills Committee, comprised of teachers and principals, to agree on a method for translating this philosophy into classroom reality. First of all, the group eliminated the idea of writing a K–12 program on thinking skills isolated from the overall curriculum or adopting a commercially published program for district use. Instead, Cherry Creek decided to focus on strategies for incorporating thinking into the curriculum already in place. This incorporation has been accompanied by concentrating on three goals.

Goal 1: To place information on teaching for thinking and teaching thinking skills at the disposal of teachers at all levels and in all subject matter areas.

Goal 2: To establish a network within the district that enables teachers to share ideas and resources on teaching thinking skills.

Goal 3: To use existing thinking skills programs that are in harmony with the instructional objectives of the Cherry Creek curriculum.

The effectiveness of the thinking skills committee has resulted from an understanding by members that their assignment would not be easy. Initially, members had to educate themselves in what it means to teach thinking skills. The committee members had to educate administrators about the value of thinking skills instruction. In a few cases, selected committee members had to exert extra effort to "educate" or persuade principals to make the necessary commitment to thinking skills instruction.

One obstacle to the work of the thinking skills committee has been the various levels of understanding among principals and teachers. Some principals and teachers could immediately see the value of designing thinking skills strategies to accompany the existing curriculums while to others the value was not quite so clear. But due to the quality of interaction between committee members and the instructional staff, these barriers have been reduced.

In addition, acceptance of the thinking skills program and competency at incorporating thinking skills strategies have been improved due to professional development activities. Examples:

1. Opportunities for teachers and administrators to share their experiences and to learn interests and skills of colleagues
   (For example, a dinner and reception, at district expense, that encouraged sharing to take place)
2. Presentations given or organized by district teachers
   (For example, a Thinking Skills Fair)
3. A newsletter with articles that illustrate how thinking skills can become a part of daily lesson plans
4. Teachers observing each other as they put thinking skill strategies into practice
   (Teachers are paired into observation teams).

Observers, noting the district's success in thinking skills, believe it is partly due to two factors: (1) Building principals eventually became convinced and committed and actively contributed to the work on thinking skills instruction; (2) the thinking skills committee itself remained highly visible through the teacher training programs and the dissemination of ideas and information on thinking skills.

But over and above these, there is the support provided by Superintendent Richard Koeppe. He has seen it as part of his responsibility to keep the public informed. And together with his board and top administrative personnel, he has helped create an environment in which his district's thinking skills committee had latitude and freedom to function effectively. Says Koeppe:

"Although public pressure for rote learning and information recall is strong, as educators we must remind the people that critical thinking and problem-solving skills are at least as important, but are far more difficult to achieve and certainly to measure. It is a challenge we must not fail to accept."

Fort Madison Community School District Fort Madison, Iowa

Not only for the gifted: How the district expanded thinking instruction for all

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In many districts thinking skills instruction has and continues to be presented primarily to gifted and talented students. In some districts with a specialized "gifted program," only the designated teachers of the gifted may receive training in thinking skills instruction. Other classroom teachers do not gain instructional competencies in this area.

Fort Madison Community School District decided to reverse this practice. The reason for the reversal was expediency. "We found that the identification of gifted and talented in the early years is often difficult," says Jean Kratz, the district resource specialist. "Therefore, the needs of bright students would have to be met in the regular classroom rather than through a pull-out program."

Kratz decided that the most expedient approach was to train primary teachers to incorporate thinking skills strategies and activities into the daily curriculum for all students.

The process began by working with kindergarten teachers who volunteer to review the literature on thinking skills instruction and later to develop a scope and sequence for thinking skills. "This started with one individual about mid-year, and by the last month of school all five kindergarten teachers were involved." Teachers were not required to participate in the work. The value of the project enticed the kindergarten teachers into participating voluntarily.

During the following school year, Kratz demonstrated lessons that reflected the scope and sequence developed during the previous year. Then the teachers were expected to practice the activity. "It was understood from the beginning that each classroom teacher would practice a similar activity during the week," states Kratz.

The model used by Kratz looks like this.

Resource person working with interested staff	to result in
Resource person working with entire group	to result in
Agreed upon scope and sequence	to result in
Resource person bringing scope and sequence to life in the classroom	to result in
Resource person training teachers in thinking strategies and techniques	to result in
Teachers practicing the strategies and techniques (with the support of the resource teacher)	to result in
Teacher competency in instruction	to result in
Student learning of thinking/reasoning skills	

"The success of this approach to teacher training was evident when nearly all first-grade teachers requested the help of the resource person for the following school year," says Kratz.

The training program proved to be a success. The students demonstrated marked growth. "Evidence of students' growth in creative thinking was apparent in their products, some were displayed at the Fort Madison Student Fair. Student growth was a direct result of teacher growth. Both teachers and administrators expressed excitement at the results of the training," says Kratz.

The kindergarten and first-grade teachers are currently revising their scope and sequence, which will be placed in notebook format to allow additions and necessary changes. The Fort Madison teachers are not looking for a definitive scope and sequence. They recognize that they are working with a flexible process.

The success of the primary grades program is indicated by the fact that intermediate classroom teachers want to receive the assistance of Kratz (whose time, of course, is limited). But, says Kratz, "for many classroom teachers, interest is just the beginning. They need help in personal development and assistance in implementing the direct teaching of thinking as a skill."

As Superintendent Stephen Williams sees it: "The success of the Fort Madison experience has depended on the presence of a qualified resource person who could work with teachers and who could provide necessary support for them. It is with the help of this resource person that we could make the transition from the teaching of thinking skills by a select group of teachers of the gifted to the teaching of thinking skills by the general teaching staff."

UPDATE: TULSA, OKLAHOMA

In 1983 Tulsa introduced the Strategic Reasoning (from Innovative Sciences, Stamford, Conn.) into two middle schools. The program was aimed at improving comprehension of students in reading and mathematics. Larry Alexander, the principal of one of the middle schools at the time of implementation, says that the program worked largely because the staffs of both schools made a commitment to improve student proficiency. "The teachers embraced the thinking program because they knew they had to deal dramatically with some difficult problems in these two middle schools," says Alexander.

By 1986 the program has been expanded to all 17 middle schools. Teachers spend one day a week focusing on thinking skills. Superintendent Larry Zenke has endorsed and supported this program, citing improved achievement and proficiency in reading, vocabulary, and comprehension as measured by several nationally recognized evaluation instruments.

Manitowoc Public Schools
Manitowoc, Wisconsin

Thinking instruction flares and fades and gets a grip on the social studies

The commitment to thinking skills instruction in the Manitowoc schools goes back three decades. In 1956, the district hired a specialist to work with teaching in developing thinking skills. The specialist, Norris Sanders, trained teachers to ask students questions that would promote higher levels of thinking during content instruction. He worked with staff to design a variety of thinking experiences that were incorporated into curriculum guides. Sanders stressed that all levels of thinking could be made appropriate for all grade levels and all student ability levels.

The work of Sanders had a strong impact on instruction in Manitowoc. Yet, this impact weakened over the years. "With the passage of time, changes in personnel, and the inroads of other movements in education, the degree of commitment by district staff to the thinking skills included in Sanders' work faded. However, the philosophy that thinking skills were appropriate for all levels of students remained strong," says Howard Wilsmann, assistant superintendent.

More than a quarter century after an initial push for thinking skills instruction, Manitowoc again refocused its energies toward thinking. Initially, district personnel taught thinking as a separate instructional area. However, this decision caused two problems. First, teachers began to view thinking instruction as an additional subject that had to be incorporated into an already busy day. Second, teachers did not have time to apply skills learned in thinking class to other curriculum areas. As a result of these problems, district personnel decided to concentrate on merging thinking skills instruction into the social studies program.

In order for this merger to yield positive results, the social studies texts had to present opportunities for thinking skills instruction. A district team of elementary teachers, including at least one representative from each grade, evaluated social studies textbooks for content that promoted thinking skills instruction. The team prepared a reference chart which summarized the possibilities of incorporating the thinking skills that needed to be emphasized into various social studies units.

Through the work of the textbook evaluation team, the instructional staff gained a clearer understanding of how to incorporate thinking skills objectives into daily textbook instruction. The end result has been a social studies program that heightens student ability to think. "Teachers have reported that students not only knew the definitions and the characteristics of the skills, but practiced the skills and identified them when they were using the skills in the content areas," says Wilsmann.

Franklin-McKinley School District
San Jose, California

Starting small, the district trains teachers to train other teachers

"Too few teachers have been concerned about inquiry training and critical thinking strategies in their daily teaching," says Superintendent Delores Ballesteros. "This became obvious during my observations in classrooms and the observations of principals and consultants."

Ballesteros' conclusion was reinforced by the observations of a California State Review Team that reported that there was a dearth of activities to promote and enhance student thought.

To increase the extent of critical thinking instruction, Franklin-McKinley established a plan that seeks the development of in-house experts.

In addition, Franklin-McKinley encourages its teachers to bring the knowledge they learn during university and other thinking-related courses to the school system.

At the foundation of the Franklin-McKinley program, however, is an understanding of teacher and student interactions. "It was essential to strengthen the teacher's understanding of how he or she interacts with students," states Ballesteros. Ballesteros believes that the success of the thinking program depends on teacher ability to communicate and listen.

Drawing from a pool of knowledgeable teachers, Franklin-McKinley trained a cadre of in-house experts. These became demonstrators of thinking skills techniques in science. Their approach was to design a series of activities that fostered student

growth in thinking development. Each activity allows students to work at their individual development levels in problem solving. Students work in groups and use one another as resources.

As of late 1985, seven teachers had been trained in this method. Their presence allows other teachers an opportunity to gain an appreciation for thinking skills instruction.

The Franklin-McKinley district has been seeking outside funding which will guarantee that thinking skills training on a larger scale can take place. The district recently received a planning grant from the Whitney Foundation to help ensure further training.

The district also has instituted a policy of providing financial support for teachers and administrators who attend courses in thinking. Those who participate in the funded courses share what they learn with other district personnel. Consequently, an increased percentage of the staff gains exposure to the theory and practice of thinking skills.

Baltimore City Public Schools
Baltimore, Maryland

District educators ask questions to determine effectiveness of four programs

In August 1983, Superintendent Alice G. Pinderhughes formed a committee to investigate procedures for increasing instructional emphasis on higher-level thinking skills, kindergarten through grade 12.

After looking at local and national test data and reviewing the research literature, the committee developed a plan which "emphasized the need for systemwide staff development and the implementation of curriculums which foster higher-level thinking skills," states Robin B. Hobbs, director of Baltimore's Thinking Skills Project.

The Baltimore thinking skills plan is based on four assumptions:

1. Improvement of students' thinking skills should result in increased student achievement
2. All students need to develop higher levels of thinking
3. Systematic teaching of thinking skills across disciplines and grade levels is necessary
4. Infusion of thinking skills is a long-term effort with ongoing staff development as a key element.

After examining various thinking skills materials, Baltimore officials decided to pilot the following in selected schools at different instructional levels:

- Philosophy for Children
- Strategic Reasoning
- Instrumental Enrichment
- Junior Great Books

For each pilot program certain questions are raised as evaluation of the materials proceeds through the use of the Scholastic Aptitude Test, the Cognitive Abilities Test, selected items from the California Achievement Test, a teacher instrument for assessing classroom climate, and a teacher observation checklist.

Here is a sampling of some of the questions being asked about the materials:

- As a result of a six-month exposure to Philosophy for Children, do second-, third-, and fourth-graders demonstrate a significant growth on specified items on the California Achievement Test?
- As a result of a six-month exposure to Philosophy for Children do third-grade students score significantly higher on the Cognitive Abilities Test than matched control-group pupils not exposed to the program?
- Do fifth-grade students who were trained in Philosophy for Children during fourth grade score significantly higher on the Cognitive Abilities Test than fifth-grade students not having this training?
- As a result of training in Strategic Reasoning, do special education students demonstrate significant growth on CAT items identified as measuring higher level thinking?
- As a result of training in Strategic Reasoning, do SAT prep students score significantly higher than a matched control group not trained with Strategic Reasoning materials?
- As a result of training in Instrumental Enrichment, do sixth-, seventh-, and eighth-grade students show significant gains on California Achievement Test scores in reading and/or math?
- As a result of training in Instrumental Enrichment, do randomly selected sixth-, seventh-, and eighth-grade students show significant increases on a teacher observation checklist score by an independent observer?
- As a result of Instrumental Enrichment training, do seventh-grade students significantly im-

prove their Cognitive Abilities Test (COG) scores relative to their earlier COG scores and when compared with a matched control group?

- As a result of a 12-week training course in Junior Great Books, do students demonstrate an increased ability to express their own ideas and to support them with evidence from their reading?

These questions and their answers guide the thinking of the Baltimore staff. The goals of the project cannot be achieved overnight. As Dr. Charles R. Hancock, associate superintendent, states:

> "We have examined our school district's basic curriculum and identified an inherent focus on thinking skills. As we continue the process of infusing thinking skills in all curriculum areas during the coming years, we will be searching for ways to help both staff and students to MAKE CONNECTIONS between fact and their larger meaning as a natural part of the thinking process. Our experience has shown that this aim is achievable."

Provincetown Public Schools
Provincetown, Massachusetts

Theory and research findings lay basis for teacher effectiveness in thinking instruction

If teachers are going to implement a thinking skills program successfully, do they need to have a grasp of theory and research behind this topic? The Provincetown schools give an emphatic "Yes" to this question. Prior to training teachers to incorporate thinking skills into classroom instruction, Superintendent Frederick Bardsley insisted that teachers have a background in relevant theory and research.

How did the district determine the type of theory and research that would meet the needs of the Provincetown students? Prior to designing the training program for teachers, administrators attended seminars on thinking skills. From this experience, the administrators were able to agree on the direction of the thinking skills program. Administrators also outlined the relevant research and the selected theories on thinking instruction which they thought would be helpful to teachers. Subsequently, this body of information was presented to teachers by specialists.

Thus prepared and briefed, teachers attended workshops that dealt with methodology for bringing thinking instruction into the classroom. The workshops required teachers to demonstrate their competency in thinking skills by presenting lessons to colleagues; the colleagues critiqued the content of the lesson and the instructional techniques of the teacher.

"By the conclusion of the program, each teacher had planned and implemented a unit designed to help students reason more creatively and systematically. Teachers concluded that the program had proved to be very stimulating and a helpful source of new ideas. The impact on the curriculum was evident as students demonstrated an increased ability to apply logic and to perceive alternative solutions to problems," says Bardsley.

The training program has given the Provincetown staff a strong understanding of thinking skills instruction. Consequently, the staff has been able to move forward confidently toward an incorporation of thinking skills into the entire curriculum. Superintendent Bardsley discusses one example:

> "The infusion of thinking skills into all areas of the curriculum in a school system presents a challenge. The many different subjects provide opportunities not only for the introduction of certain higher order thinking skills but their reinforcements as well. Our main goal as educators is to meet this challenge with creative solutions."
>
> —Alice G. Pinderhughes
> Superintendent, Baltimore City
> Public Schools.

"In 1985 our elementary social studies curriculum committee developed a critical and creative thinking skills program that teaches students how to make decisions and how to solve problems. This model will become the major emphasis of our social studies curriculum which is being designed during the 1985–86 school year by all elementary teachers. Upon completion of our social studies curriculum development, we plan to proceed through all subject areas, kindergarten through grade 12."

Dubois Elementary School
Dubois, Wyoming

How instruction in thinking promotes discipline and positive student behavior

"Our purpose is to emphasize thinking strategies among students throughout the school day," says Principal Mervin Lindsey. The teachers and administrator at Dubois Elementary School have made it a goal to harness thinking strategies for the enhancement of student behavior and the improvement of student discipline day by day.

The meshing of discipline and thinking is based on five premises:

1. The school must allow choices that inevitably lead to good choices (and the benefits derived from them) and poor choices (and the burden of living with them).
2. In its disciplinary practices, the school needs to convey the concept that individuals must surrender some of their rights to preserve and protect the remaining and the more important of their rights.
3. Through school experiences, pupils should be helped to realize that the immediate privilege surrendered to the group usually serves their individual interests in the long term.
4. The school discipline should be so administered that individuals come to understand that it won't work for them to pick and choose those rules which they will follow. They must abide by them all and, if necessary, work to have poor rules changed.
5. The program should provide opportunities to practice the social skills of "working out" disagreements and conflicts along with a way of requesting arbitrating assistance if necessary.

Lindsey and his staff have worked consistently to bring thinking practices into daily situations at school. they have established guidelines which encourage students to solve problems that immediately affect them. "It is relatively easy to set up rigid guidelines for students to follow unthinkingly," states Lindsey. "However, understanding, not compliance, is the bulwark of our type of society. As a school and as individuals, we have a stake in our people becoming self-disciplined individuals, with the aid of thinking skills."

In order for discipline through student thinking to be effective, the staff at Dubois Elementary agreed upon a set of guidelines, some of which are based upon the Steps of Effective Discipline advocated by William Glasser. Among the guidelines are the following:

- Pupils are encouraged to solve their individual and group problems with as little adult interference as possible.
(The adults structure time and place arrangements for pupils to think or to discuss conflicts of personality or behavior. Adults moderate discussions only if necessary and intercede as a last resort.)

- The adults in the school view conflict as an opportunity for learning more about each other and for fostering a greater interpersonal understanding.
- No discipline is administered that emanates from adult frustration.
- Each pupil is considered and treated as an individual having unique feelings, needs, and backgrounds.
- In all discipline infractions the pupil and teacher have a responsibility to try to find underlying causes or motives prompting the behavior. At times, the understanding will, in itself, be sufficient to encourage a child to discontinue the behavior.

In Dubois, teachers encourage students to solve their own behavioral problems, rather than provide a highly rigid system of disciplinary actions. As students come to realize that they can use their thinking skills in situations which are not always necessarily directly related to content learning, they become more confident in their ability to resolve conflict of opinion.

Detroit Public Schools
Detroit, Michigan

Thinking skills for all: This district leaves no one out

When it comes to making thinking skills instruction available to students, Detroit covers all the bases. The district has offerings for the college-bound, the talented and gifted, students with academic deficiencies, kindergarteners, high school students, and all grades in between. Thinking skills are taught in separate courses and they are also infused into the curriculum and into extracurricular activities. The schools use commercially available programs, as well as approaches developed by teachers and supervisors. One of Detroit's main interests is the urban student.

Here is a list of selected projects and programs through which Detroit is promoting higher-order thinking skills:

1. ***Improving Reasoning Skills of Urban High School Students.*** Detroit is one of six large urban districts participating in the Improving Reasoning Skills of Urban High School Students Project, which was initiated during the 1983–1984 school year. The purpose is to improve students' chances for success in college by improving their reasoning skills. It is being funded by a grant from the College Board. The program operates in mathematics and English courses in five Detroit high schools. Five reasoning skills are emphasized: observation, inference, generalization, organization, and evaluation.

2. ***Choices for Positive Living: Interpersonal Cognitive Problem Solving.*** For kindergarten and lower elementary grades, this program is directed at improving students' self-esteem and social behavior through developing decission-making skills and capacity to handle relationships with peers and adults. Among skills stressed are choosing among alternative solutions, thinking about consequences, thinking about means and ends.

3. ***Higher-Order Thinking Skills.*** This is a computer-based problem-solving program for elementary grades in pilot stage. A computer laboratory is used to teach critical thinking to children who have academic deficiencies.

4. ***Teaching Problem Solving (TOPS).*** These mathematics activities are being used in 45 middle schools to help students develop imagination, ingenuity, and intuition as they engage in problem-solving games and experiences. The program was developed by CEMREL Regional Educational Laboratory.

5. ***Academic Games.*** This citywide middle and high school activity offers activities that require higher-order thinking skills. Tournaments involve language arts, mathematics, and social studies. Training for the games includes instruction in small groups, peer teaching, independent research, group practice on the games themselves (such as Equations, Linguishtick, WFF'N Proof, On-Words, World Cards, and Mr. President).

6. ***International Conflict Simulation Project.*** This is a pilot program in which students use computer simulation activities as they analyze and respond to given data on how to resolve conflicts between nations. The materials were developed at the University of Michigan.

For more information write Allen Zondlak, Detroit Public Schools, 5057 Woodward Avenue, Detroit, MI 48202.

Dallas Independent School District
Dallas, Texas

Thinking strands weave through the Dallas curriculum, grade by grade

Thinking strands and Dallas—the two have become inseparable during the past five years. Today, the Dallas approach to thinking instruction embodied in "thinking strands" is known all over the country. Linus Wright, general superintendent, Dallas Independent School District, has shared his experience with school administrators in scores of districts—"whoever asks gets the story."

The significance of the story lies in two statements by Dallas officials:

"A student who enters Dallas schools in kindergarten and completes the 12th grade will have systematic, continuous content-specific instruction in thinking."

"Dallas is probably one of the first districts in the country to identify thinking skills to be taught at each grade level."

Dallas officials back up these statements with a conviction, a commitment, and curriculum revision work going back nearly a decade.

The conviction is clear: "We have believed for years that thinking is a skill that can be taught," says Wright. The commitment to make this belief a reality had to be strong, because organizing the processes for instruction in thinking was no easy matter.

The background of the thinking strands concept began, in essence, with the Texas legislative mandates for educational reforms of the early 1980s. Even before the curricular reforms became law, Wright reorganized the system's curriculum and instruction division and charged his senior staff members with updating and modernizing the courses of study so that thinking, as a skill, would be taught systematically, K–12, within the curriculum.

A serious question arose immediately. How do you create and organize a thinking program that impels teachers to make thinking skills part of classroom life? Obviously there had to be a philosophic change in the district—a change in the mental attitudes of teachers and principals; specifically, not only that thinking can be taught, and taught to all students (not only the gifted), but that it can be taught day by day through the content of the curriculum. Faculty had to come around to believing, as the research and consultants told Dallas officials, that thinking cannot be taught only in a special time, set apart and aside from daily lessons.

Says Sandra Santillo, who is in charge of Dallas thinking program: "As long as thinking was associated in the minds of teachers with an add-on program, and not considered part of the content, we knew there would be problems with making thinking skills instruction a reality."

But Dallas has infused thinking strands into English, social studies, science, health, mathematics, fine arts and vocational education. And the result is an experiment of grand proportions.

For details, write to General Superintendent, Linus Wright, or Sandra Santillo, Dallas Independent School District, 3700 Ross Avenue, Dallas, TX 75205.

Because of his experience, we asked Wright the following questions about thinking skills:

1. What is the role of the superintendent in developing a thinking skills program?

It is up to the superintendent to establish and to communicate his or her belief in logical thinking and to make it a top instructional priority in the district by mandating the development and implementation of a K–12 thinking skills curriculum.

2. What hinders effective design and development of the thinking skills program?

Lack of support from top management may be the hindrance. As with any new program, it is necessary to foster among top management a belief in and support of the thinking skills curriculum. Top management, in turn, must convince those who implement the program of its importance. Because the teaching of thinking skills does not fit into any one place in the curriculum and yet applies to every subject area, it can slip through the cracks and be neglected if someone is not assigned responsibility for it at all levels.

3. What lessons has Dallas learned from the implementation of its thinking skills program?

Get broad-based support for the program by communicating with board members, top management, principals, teachers, students and the community.

4. Is the current emphasis on thinking skills an educational fad?

Thinking is the basis of all skills and must be an integral part of any educational program. Therefore, the teaching of logical reasoning prdcesses must be a top and continuing instructional priority. I would not use the word "fad" to define such a necessary component of educating our youngsters.

5. What direction is Dallas moving toward with its thinking skills program?

In our district's Language Arts/English and Mathematics Departments we have designed K–12 curriculum strands for the teaching of logical reasoning. To implement these strands, a K–12 teaching skills program also has been developed. We now are in the process of printing the curriculum and training logic coaches from each school to advance this program further.

A Superintendent Works with Staff toward Infusing Thinking Skills into the Existing Curriculum

—A personal statement by William Streich,
superintendent of schools, Farmington, Connecticut

Farmington, an affluent suburban community near Hartford, is in the process of developing a thinking skills program uniquely its own. Superintendent Streich's account presents an example of the slow, deliberate work involved in such an effort.

We have been working on thinking for three years here in Farmington. When we first began to explore the topic, Robert Sternberg, from Yale University, came to talk with teachers and administrators about his triarchic theory of intelligence and about his ideas on teaching thinking. Sternberg left a manuscript copy of his book, *Understanding and Increasing Your Intelligence*. Members of the group dabbled with lessons from this book.

Some of our teachers were already receptive to learning more about cognitive skills. For example, Claire Clark, a local math consultant, trained our primary teachers in a four-step problem-solving procedure in math: understand the problem, determine alternative solutions, try the best one, and evaluate your solution.

In still another early move, we invited Robert Pauker to train interested elementary and secondary teachers in questioning strategies. Teachers learned how to train students to ask higher order thinking questions.

Involving the Faculty

At the opening convocation for teachers in September 1984, I spoke about the importance of teaching thinking and provided examples of several approaches. The faculty completed an exercise that used deBono's strategy of PMI; this strategy calls for the thinker to consider a problem through the pluses (P), the minuses (M) and that which is interesting (I). The group used PMI to explore the idea of placing all high school seniors in one building.

During that convocation I also presented examples from the work of Reuven Feuerstein (taken from his *Instrumental Enrichment* program) and Matthew Lipman (from his *Philosophy for Children*). The essence of my message to the teachers was that they needed to experiment with ideas that would promote thinking.

During the 1984–1985 school year we tried several programs. We had one teacher who had received the training in Matthew Lipman's *Philosophy for Children.* This teacher implemented the program in his classroom and helped five or six other teachers use the program on a regular basis.

Several teachers tried CoRT by Edward deBono; others practiced Clark's problem-solving approach and Pauker's questioning and comprehension program.

In the spring of 1985, 20 teachers, who had worked with various thinking skills programs, evaluated their experiences with them. Many of the reactions that came from a half-day conference were frank and illuminating.

"Lipman's *Philosophy for Children* needs a motivated, sensitive teacher or it's a drag."

"DeBono's materials lend themselves to integration during content instruction."

"Feuerstein's materials require long periods of teacher training and as a result may not be worth the effort."

"There is real potential for integrating thinking into our process approach to teaching writing."

Facing Crucial Issues

In the fall of 1985 we moved into a second year of experimentation and evaluation. Teachers and administrators continued to implement selected thinking programs and to improve their understanding of cognitive skills by reading and attending conferences.

One central issue we began to address was: Should a thinking program be driven by the learning of broad heuristics or by learning many isolated thinking skills? To put it another way, should we teach our students a number of general strategies or "rules of thumb" they can use in solving problems and making decisions, or shall we teach them a series of isolated thinking skills in the hope they will be able to apply them to school and life situations?

So far, our experimenting in Farmington has shown the value of heuristics. People need handles or crutches, if you will, to help them think. Personally, too, I lean toward the idea of having students learn three or four sets of general strategies and look upon such heuristics as the centerpiece of thinking programs.

Farmington is now confronted with another question. Will thinking skills be built into daily lessons in science, social studies, math, and English? Or, will they be taught as emerging from prepackaged plans and programs?

Why Some Innovations Fail

From my experience over the years, I've found it easier and more effective to build innovations into the existing curriculum rather than to implement them as isolated strategies or teaching techniques. If the thinking skills become part of the sequence of daily lessons for a subject area, then teachers are required to foster student thinking. If the thinking skills instruction is perceived by the staff as a series of independent strategies, then teachers will not foster thinking in an organized way.

"Many of the "teaching innovations" of the 60s and 70s were techniques without curriculum. They are now forgotten. On the other hand, the S.C.I.S. science program is an example of a thinking process that is an intricate part of a curriculum. S.C.I.S. shows students how to think like a scientist. The program incorporates the scientific method into daily classroom lessons. Thinking is a way of life in the science class. Fifteen years after we implemented S.C.I.S., the program is still going strong and teachers of science also teach thinking.

Thinking Goes With Content

Yes, educators have to integrate the teaching of thinking into the curriculum. Initially, there may be a patchwork quilt, as in Farmington. Some patches represent basic principles of thinking and other patches represent content. Our goal must be to convert the patchwork quilt into a Harris tweed—a smooth blend of thinking and content.

As we move ahead with thinking skills in Farmington we will use two opportunities to integrate thinking into the curriculum. We have recently completed participatory evaluations of our math and social studies programs. Recommendations call for integrating problem solving and thinking skills into each of those programs. Our approach will be to develop thinking skills units and lessons into the curriculum in those subject fields.

How the Thinking Movement Affects Instruction in Subject Matter

A trickle-down process affects teaching and learning—Textbook publishers in race to include more material dealing with thinking and reasoning—Mathematics instruction moves from computation and search for "right answer" to reasoning and problem solving—How good science instruction leads to good thinking—In social studies; thinking makes the lesson—Making reading a thinking process

A trickle-down process—from leaders of thinking instruction to the curriculum office and the classroom—is having an impact on what is being taught. It is a slow trickle, but it is pervasive. It affects mathematics, science, social studies, and reading; and there is scattered evidence that thinking skills get some attention also in the arts, home economics, and physical education.

The slow trickle process takes these manifestations:

- The formal thinking skills programs, now finding their way into some school districts, open up for the teaching staffs new worlds of the mind. Teachers get to know—and it's a first time for many—about the workings of logic, how students learn, the importance of comprehension, of analysis, of creative solutions to problems. "It is a fair surmise," said one leader in the thinking movement, "that the thinking concepts being discussed at workshops and inservice sessions rub off, to some extent, on many teachers regardless of what they teach."
- Curriculum directors remind teachers that there is more to the daily lesson than the transmission of facts or the student's repetition of them—that there are also discovery, inquiry, insight, finding more than one answer to a problem. In this effort, curriculum workers are aided by, and get reinforcement from, thinking skills proponents. Curriculum workers also succeed, more than previously, in injecting into curriculum guides exercises in higher order mental processes. "Mathematics, science, and social studies especially have been refreshed by ideas now being brought out by the thinking movement," one curriculum director said recently.
- "If it's in the textbooks, teachers will teach it," is an old truism. By 1987, textbooks and other instructional materials included more exercises in critical thinking and suggested more projects for student creative thinking than ever before. Yet, such material was only the beginning. A check with ten major publishers of the nation's textbooks revealed these views:

> "Nearly all textbook publishers are in the midst of intensive talks with authors and cognitive scientists on how to make the textbook a sharper tool for thinking skills instruction. . . ."

> "It's nothing new; just an intensification of a longstanding practice. Our science and math texts have always placed heavy stress on analysis, problem solving, application, creativity. Now we'll do more of that. . . ."

> "Textbook publishers are vying with one another to see who can be first with the most pages providing problems which begin with those thought-provoking words, *Classify, Explain, Compare, Interpret, Deduce, Criticize, Differentiate, Propose, Create*—and on and on. . . ."

Mathematics
From computation to reasoning

For generations, instruction in mathematics was tied to the requirement of computing "correct answers" by students. This teaching tradition was interrupted, briefly, in the 1960s when the New Math required that students not only supply a "correct answer," but explain how they arrived at their response.

The New Math proved to be too abstract, even for some teachers; the majority of them could not put the New Math procedures to work in their classrooms. Inevitably, the pendulum returned to the traditional methods of instruction where computation and the "correct answer" were dominant.

But today under the influence of the thinking movement, more and more mathematics teachers organize their daily lessons around problem solving. In this, they have the help and encouragement of their local supervisors, as well as of national leaders in mathematics.

To wrench mathematics from dependence on traditional computational exercises is still a major task. Computation is still necessary. But computational skills are losing their primacy because of the hand-held calculator and the computer. The use of these mechanical aids leaves, or should leave, more time for understanding the rational and real number systems, for use of deductive and inductive reasoning, for organizing and interpreting information, and for drawing and testing inferences. Such processes underlie both good thinking and good mathematics at all grade levels.

In working with students for higher order mental processes in mathematics, teachers *decrease* emphasis on such activities as—

- —isolated drill apart from problem contexts
- —performing paper and pencil calculations with numbers of more than two digits
- —memorizing specialized vocabulary not used later either in mathematics or in daily living
- —working with tables whose usefulness as aids in calculation has been supplanted by calculators and other technological aids.

Instead, says the National Council of Teachers of Mathematics (NCTM), math teachers *increase* emphasis on such activities as—

- —locating and processing quantitative information
- —interpreting data
- —drawing inferences and predicting from data
- —mentally estimating results of calculations
- —calculating with numbers rounded to one or two digits
- —using imagery, maps, sketches, and diagrams as aids to visualizing and conceptualizing a problem.

Science education—
Thinking skills to the rescue?

Good science instruction leads to good thinking: good instruction in thinking skills leads to good science.

Educators who believe in this interaction are among strong supporters for (1) improving the science curriculum and (2) the continued pervasiveness of thinking skills in the classroom. They see hope in this combination for some relief from the "crisis in science" which doesn't seem to go away.

The crisis in science has divers roots and causes. To name half a dozen:

1. Lack of adequately prepared teachers for elementary science
2. Shortages of qualified teachers for high school science subjects
3. Textbooks that are mere encyclopedic collections of science facts
4. Inadequate time on task for science
5. Pressure on teachers to cover all chapters in the book and to produce students who score well on standardized science tests
6. Misconceptions among teachers, science educators, statesmen, and the public as to what science is and what science education should achieve.

Reform and innovations of the past have not helped much in ameliorating chronic weaknesses in science education.

The New Science of the 1960s stressed abstractions and insisted that "students behave in the classroom the way scientists behave in their laboratories." The proposed remedy failed. In counter-reaction to this came an emphasis on basics, which lead to a return to 19th century verbalization, memorization, and recitation of textbook material. The 1980s proposals for higher standards—more required courses and tougher subject matter—suffer as a remedy because of unqualified teachers, lack of laboratory facilities in schools, and less-than-challenging instructional materials for students.

The composite complaint, when you line up a variety of views on the present state of science instruction and learning, is this: students work at their science books and materials without thinking. Set up a problem for them, tell them "how to do it," and they'll "do it." Students in science are not pondering, ferreting out, working at materials, experimenting on their own, exploring. Essentially, they are looking for the one answer and the right solution that will satisfy their teachers.

Such a state of affairs adds up to poor science learning. Can the thinking skills movement come to the rescue? Some educators believe that could happen. Their reasons:

The process of science runs parallel to the process of thinking. In both, it is necessary to identify a problem; to gather, classify and analyze data; to set up tentative hypotheses; to seek for cause and to see relationships; to verify hypotheses and apply results—and to see if the solution holds true.

The affinity between thinking and science instruction can be stated in other ways, as well. Science educators stress that science lessons should be concerned with discovery; should lead to decision making; should encourage students to reach for creative answers; should give free rein to insights. Discovery . . . decision making . . . creativity . . . insights . . .these are but four elements that underlie both thinking and science education.

Social studies—Thinking makes the lesson

Pressure to incorporate higher level thinking into daily social studies instruction is mounting. "Leaders in social studies of many states are making a big push for teacher training that will include more thinking skills concepts," says Norbert Cieslak, of the National Council of Social Studies (NCSS). The State of California bases its critical thinking assessment on social studies content. In Pittsburgh, educators have designed a critical thinking evaluation program that requires students to construct analytical essays based on social studies problems. As other case studies show (see page 56), school districts find the social studies curriculum a favorite for infusing thinking skills.

Some social studies teachers expect the thinking movement to set in motion a "second renaissance" in their discipline. The first renaissance, they say, may properly be placed in the 1960s, when Hilda Taba's influence began to cominate the social studies field. Taba's great contribution was to link social studies subject matter with thinking processes. Spurning memorization and regurgitation of fact and definition, Taba set forth a model for social studies instruction which required students to gather and categorize facts, identify key concepts and ideas, make inferences, generate hypotheses, predict consequences, and verify predictions.

During the 1960s, too, educators conducted hundreds of what were then called "study groups" and "curriculum projects" which sought new directions for social studies.

The major aims of that first renaissance were (1) loosening the straight-jackets of history, geography, and civics in favor of multi-disciplinary study and (2) demonstrating the importance of inquiry for the student. These two approaches were almost lost during the 1970s when back-to-the-basics advocates called for teaching "straight" history, geography, and civics, and all but drove inquiry from the classrooms in some districts.

Today, thinking skills leaders are helping to restore the values of these all-but-lost approaches to social studies. They are also restoring to new importance such teaching strategies in social studies as:

- Emphasizing concepts and generalizations. Teachers are encouraged to focus on relationships of facts and to help students understand the concepts that form and influence society.
- Encouraging discovery and induction in learning. These two processes (which have major roles in thinking) help prepare students to investigate independently social studies problems.
- Drawing facts from a deep—and ever-deepening—well of knowledge, which includes anthropology, criminology, economics, ecology, industrial relations, jurisprudence, religion, semantics, and other disciplines. Neither thinking, nor the solution of social studies problems, can depend on a narrow band of facts.
- Analyzing controversial issues. Sorting out the true and the false, the significant and the insignificant, hot-air rhetoric and substance, facts and alleged facts—such skills are as crucial in thinking as they are in mastering social studies content.

"Almost any good lesson in social studies can become a lesson in critical thinking," one expert said recently. In support of this assertion, he pointed to the current project of the National Council of Social Studies dealing with public policy issues. A public policy issue is a question such as "Should capital punishment be abolished?" or "Should immigration be restricted?" According to the Council, the teacher who takes up public policy questions in the classroom is also, in effect, undertaking instruction in critical thinking.

Tedd Levy, a leader in the Council, illustrates this in his brochure entitled "Public Issues Program Discussion Guide," published in 1986. He writes that in tackling public policy questions students should be taught the following precepts:

- All opinions are not equally valid. An opinion that is supported by reliable evidence, that is consistent, that offers useful definitions of vague terms is more valid than a position that is unsupported by evidence, is inconsistent, and uses ambiguous language.
- Changing our minds when confronted with a more reasonable position is not a mark of inferiority. Stubborn adherence to a position for the sake of winning or saving face is irrational.
- People with opposing views can be taught to value mutual clarification and exploration. The

purpose of discussion is not to defend views; it is rather an opportunity to work out what our views actually are.

The teacher who teaches such basic premises in social studies is also teaching critical thinking.

Reading— A thinking process

The ultimate purpose of reading is to understand the meaning behind the words being read. "As long as 30 years ago reading experts knew that without comprehension you don't have reading," says Ron Mitchell, executive director of the International Reading Association (IRA).

Comprehension refers to the reader's ability (1) to infer meaning, (2) evaluate the behavior of characters in a story, (3) appreciate the author's intent and style, (4) apply the information in print to other knowledge or experience. "The successful reader has been and will continue to be required to think; reading is a thinking process," says P. David Pearson, authority on reading at the University of Illinois.

If the reading process has always demanded students to think, is the thinking movement an additional impact on reading instruction? Yes, says Pearson. "Teachers are becoming more skilled in how and when to ask the types of questions that promote critical thinking."

In reading instruction that promotes thinking teachers go beyond being satisfied with students breaking the code or knowing the dictionary definitions of words. They continually ask: What do you think this means? What do you think the author had in mind? Do you see any flaws in the portion you've just read? What is your reaction to what you've read?

Further, to promote thinking among as many students as possible, teachers "spread" their questions among the retiring and slow-learning students, as well as among the bright and aggressive ones. Teachers permit an adequate amount of wait time between a question and the expected moment of student response. They are patient; they do not finish what the student has started to say. They encourage discussion; they encourage students to ask questions.

Eight levels of reasoning may be developed during reading sessions at all grade levels and for all types of students. According to Elise Murphy Rowe, a reading specialist at Downers Grove, Illinois, these are:

Literal—What does this information say?
Reorganization—Where does this information fit?
Interpretive—What does this information mean?
Evaluation—How good is this information?
Appreciation—How does this information make you feel?
Application—How can you relate this information to a new situation?
Integration—What lasting effect will this information have on me?
Creative—What new ideas are sparked by this information?

How Teachers Activate Student Thinking

Here are eight teacher behaviors that activate student critical thinking and skill achievement. F. Lee Winocur, the director of Project IMPACT in Orange County, California, has spent several years researching and corroborating those behaviors.

Teacher Behavior	**Explanation**
Modeling/demonstrating	In every lesson the teacher models or exhibits the thinking behaviors that she or he seeks to elicit from the students. The teacher encourages the student to imitate the thinking skill after it has been demonstrated by the teacher.
Cueing	The teacher uses a vocabulary of phrases that introduce or are imbedded in high-level teacher questions. Those phrases soon become familiar to students as cues for reflection, analysis, or for formulating hypotheses.
High-level questioning	The teacher asks open-ended questions and encourages students to generate and explore alternative solutions.
Promoting interaction	The teacher asks students to work in groups when engaged in problem-solving activities. Cooperative learning has been shown to facilitate the higher-level thinking of each group member.
Probing	The teacher asks a well-planned series of questions leading the students to generate a rule of generalization.
Symbolizing ideas	The teacher presents a series of graphics or visuals that enable students to remember concepts.
Reflecting with wait time	The teacher provides the students with enough time to formulate a response to high-level questions.
Teaching for transfer	The teacher helps the student to identify a broad range of applications of the skill being taught to a variety of situations.

How Your School Board Can Become Involved In—and Support—Thinking Skills Instruction

Concepts for your school board members—Thinking skills are for all students—Thinking promotes academic achievement—How to present thinking programs to the board, and when—Six teachable moments for educating the board about the thinking movement.

The surge of interest, and the wave of excitement, about thinking skills are well-known to forward-looking administrators and alert teachers. The public, and boards of education, representing the public, remain largely unaware of the movement. This is shown by almost any list of priorities coming from the public or boards of education. A 1985 survey of school board members, by Virginia Tech's Northern Virginia Graduate Center, Falls Church, Virginia, showed that the top concerns of boards members are financial support, declining enrollments, collective bargaining, parents' lack of interest, student use of drugs. Critical thinking for students is nowhere to be seen on the list. Neither does the topic appear in the Gallup Poll survey of concerns by the public. As it has for years and years, the public believes, according to Gallup, that lack of discipline, use of drugs by students, poor teaching—in a list of more than a dozen issues—are the chief problems in American schools.

Educating the board of education and the community on the importance of thinking skills, is, therefore, a major challenge for the superintendent and one that will take not months but years. School districts that think in terms of long-range goals—five to ten years—will have the best chance of bringing thinking skills to the foreground of board goals and concerns.

Long-range goals have a strategic advantage in educating the board and the community on this topic. They show that the administration is not rushing into things; that it is not jumping on bandwagons or joining transitory movements that are here today and elsewhere tomorrow. A long-range view and long-range set of goals will help build board member attitudes that, in time, may come to the surface as strong support for the incorporation of thinking skills in day-to-day instruction.

The superintendent who is persistent in keeping the issue of thinking skills before the board can use a number of arguments (or concepts) to good advantage, adding or changing them as conditions suggest. They are:

- ***Thinking skills are for every student*** of every level of ability and of every family background. It is not the purpose of thinking skills instruction to develop an elite, nor is it its purpose to serve only the gifted or the college-bound. The purpose of such instruction is to equip all students with the skills they need for better mastery and management of information

- ***Thinking skills are not gimmicks*** for intellectual gamesmanship. They are practical and necessary talents for every human being. For students of every grade, the application of thinking skills can improve achievement and raise test scores in writing, mathematics, science, social studies. There are good reasons—though not entirely conclusive—to believe that rational thinking on the part of the student may reduce the incidence of disruptive behavior and improve discipline.
- ***Instruction in thinking skills is not new,*** radical or revolutionary. Its importance has been recognized for centuries. All good teachers—from Socrates, through the millenia, to your top-notch teachers, in say, science or math—have sought to do more than transmit facts to students. They have also tried to help students arrange, analyze, interpret and evaluate facts (which is a short, incomplete, almost simplistic way of saying they have tried to get students to think). And many a teacher and administrator claim that "We in this district have been concerned with thinking skills for years." There is always *some* truth in such statements.
- ***Thinking skills instruction is a movement in line*** with national trends and will grow during the years ahead. As the old wisdom has it, your district may not want to be among the very first to get into the mainstream of thinking skills instruction, nor would it want to be among the last.

These arguments, and others, on behalf of thinking skills, will have impact on the board of education when presented at the right time, under the most promising conditions.

When is the right time?

Good teachers take advantage of "teachable moments," those times when students are "ripe and ready" for the acquisition of new facts, new skills, new attitudes, or new understandings.

Similarly, the adroit superintendent seizes the "teachable moments" when the board is in a position to grasp underlying facts and concepts of thinking skills instruction.

Such times occur, or can be created, by the administration at the following instances:

- When the board is involved in developing new policies, or updating existing ones, dealing with critical thinking. Drafting, revising, approving, and adopting written board policy statements on critical thinking may take many board meetings, many hearings, many sessions for discussion and factual presentations. Each such session is an opportunity for the administration and faculty members to "educate" the board—to tell why critical thinking should be part of the curriculum, how the administration will seek to implement it and how the teachers will be helped to make it a reality in the classroom.
- When the board reviews courses of study, subject-matter programs, and other aspects of curriculum. Here are opportunities for department heads and curriculum supervisors to tell the board not only about the content being adopted, changed, or updated, but how that content will be used for the enhancement of thinking skills. Thinking skills should come into consideration not only when the board looks at reading, writing, mathematics, science, and social studies, but also at such areas as health education, guidance, vocational education, sex and family education, and the arts. The board should know that there is a role for critical thinking in every lesson taught in every classroom.
- When the board looks at instructional materials—from textbooks to the array of electronic and nonelectronic teaching and learning aids. Here the administrator has fresh opportunity to inform the board how modern instructional materials incorporate lessons, exercises, problems, and strategies for the promotion of thinking skills; and how teachers will use these resources in their classrooms.
- When the board reviews the district's inservice or professional development programs. The staple of inservice education is the renewal of teacher skills in subject-matter instruction, and boards have few problems in accepting, and in paying for, such training sessions. When inservice education is on the board meeting agenda, tell board members your plans for helping teachers to teach thinking skills.
- When the board builds, revises, or updates the operating budget. Do any of the budget items reflect the district's interest in thinking skills? Tell the board about it. Are you asking for funds to hire consultants, specialists, and teacher-trainers in thinking skills? Tell the board about *them.* Are you asking for funds to set up workshops, seminars, experimental studies or to devise testing materials on thinking? Give the board background information, explain reasons for your actions, justify the needs. Budgetary moments are teachable moments. They are a time when board members will make an effort to understand—and to react—to what you are requesting in your budget estimates and requests.
- Finally, there are the direct "teachable moments" when you schedule, for districtwide staff, talks on the thinking movement in the United States; or presentations dealing with new developments in teaching thinking skills. Invite board members to attend—some may surprise you and accept your invitation. Urge and encourage board member participation in such events—making reasonably certain, first, that what is to be said on the platform will be clear and interesting to the audience. A dull, technical presentation will set

your thinking skills program back for who-knows-how-long.

Such "teachable moments" for the superintendent to seize and use will appear and reappear; or, they can be created as often as you find expeditious. Educating the board on the importance of thinking skills is an open-ended process. To succeed, the superintendent (1) must stay informed about what is happening in the movement to enhance thinking skills among students; (2) must stay in touch with other school districts that are venturing, successfully, into thinking skills programs; and (3) should use all possible opportunities to keep the board informed of events, developments, and trends in thinking skills instruction.

Robert Ennis Responds

Four states—California, Connecticut, Michigan, and Pennsylvania—have mandated testing for thinking skills. What is your opinion of the developers of these tests?

They're doing pioneering work. They're trying to deal with the inevitable disagreement among people as to what constitutes thinking. Test developers have political pressures from unions, administrators, and subject matter organizations. It's difficult to accommodate all of these pressures. But they're starting out in the right direction.

—Robert Ennis, University of Illinois, is an authority on evaluation of critical thinking instruction.

Assessing Results of Thinking Instruction: Tests, Approaches and Limitations

A look at the major types of thinking tests—Nature of standardized thinking tests—What state competency tests try to tell—Measuring higher-order thinking skills in content areas—Future of thinking skills evaluation.

So you want to know whether your district's instruction in thinking skills is effective. You want to know whether thinking makes a difference in student achievement.

You turn to evaluation.

The basic types of evaluation used throughout the country are:

1. The standardized thinking test (with multiple-choice response)
2. The standardized thinking test (with essay response)
3. The state competency test (with multiple-choice response)
4. The school-designed test (essay response)
5. Standardized basic skill and achievement tests in content areas (with multiple-choice response)
6. Teacher/administrator observation and diagnosis

1. The Standardized Thinking Test (multiple choice)

The current guru of thinking skills testing is Robert Ennis, University of Illinois. Ennis' influence transcends both the standardized tests market and the state competency testing arena. He is the principal author of the *Cornell Critical Thinking Test*, levels X and Z.[1,2] Level X of the test is designed for students in grade 4 through the college sophomore year. Level Z is written for advanced high school students, college students and adults. The author explains the intent of the tests:

> They are called "general critical thinking tests" because they attempt to cover . . . critical thinking skills as a whole. In contrast, an aspect-specific critical thinking test would be aimed at only one aspect of critical thinking ability, such as ability to make reasonable judgments about the credibility of a source of information.

These tests focus on induction, deduction, observation, credibility, and assumptions. Each test requires 50 minutes. Special directions are used when administering the test to elementary students.

A second standardized test is the *Watson-Glaser Critical Thinking Appraisal*,[3] designed for grade 9 and above. It consists of 80 items that measure five areas—inferences, assumptions, deduction, interpretation, and evaluation of arguments. The readability of this test worries some specialists. The literature describing the test claims a ninth-grade readability. Edward Glaser, one of the test authors, encourages teachers to review the test with students following its completion; this review, Glaser feels, can increase student understanding of how to use the five areas measured by the test. Teachers who choose to go over test items to increase student understanding must gain prior awareness of questions because no item-by-item explanation exists.

2. Standardized Thinking Test (essay response)

The *Ennis-Weir Critical Thinking Essay Test* is designed for secondary and college students.[4] Students are asked to write a letter to the editor of a fictional newspaper. Student responses are then scored according to specified guidelines. The authors state: "The criteria and scoring suggestions for grading the test are to be used flexibly and with judgment." A manual explains the scoring procedure to teachers, so that they are equipped to score the instrument.

The authors of the test note two purposes:

> As a test, the Ennis-Weir has both instructional and research uses. It can be used as a diagnostic device to identify specific areas of reasoning or argumentation with which groups of students may need help. . . .
>
> For research purposes, the test could be used as a basis for comparing control groups and experimental groups in an experimental study. One might want to investigate, for example, the effects of instruction in informal logic, science, social studies, or literature on critical thinking ability. Finally, the test could be used in an exploratory pretest-posttest design, providing educated guesses about the effects of a "specific" curriculum.

The diagnostic value of this test can be heightened if the scorer demonstrates flexibility and judgment. The scorer must also remember that this is "a test of critical thinking ability, not writing ability" (Test Manual, page 3).

The *Test of Logical Thinking* and the *Group Test of Logical Thinking*,[5,6] require that students supply answers and explain their answers as they apply to various types of reasoning tasks. Through these tests, it is possible to gain insight into student ability to solve problems and the processes that students use in the problem solving.

3. The State Competency Test (multiple choice response)

California, Connecticut, Michigan, and Pennsylvania have mandated that a critical thinking component be incorporated into state proficiency examinations. California has progressed the furthest in developing these instruments. Forty percent of the items on the California history-social science state competency test for eighth-graders measure critical thinking. In addition, a sizable percentage of items on existing proficiency tests in reading, language, and mathematics focus on critical thinking.

Peter Kneedler, who has exerted the strongest influence on critical thinking testing in California, believes that one advantage of California's competency testing of thinking skills in history-social science over a standardized test is the number of items in the testing pool—no less than 720 questions. Each form of the test is comprised of 20 items. Students receive one of 36 possible test forms. Therefore, teachers cannot coach prior to the test. Kneedler emphasizes the disadvantage of the traditional standardized test in these words: "In a standardized test, the teachers can teach to 30 questions that appear on the test (year after year). As a result, students can memorize answers and their scores go up."

Responses to test items can be used by teachers to determine areas of student strengths and weaknesses. Here are three sample items from the California History-Social Science Test that can be used for diagnostic purposes:

Sample Item:

"Women should have the same job opportunities as men. Whether it be cook, firefighter, executive, marine, or astronaut, no position should be denied a woman, except, of course, those positions requiring considerable physical strength."

Is this speaker being consistent?

A. No, because he fails to mention the Constitution, which guarantees equal rights to all men and women.

B. Yes, because the speaker does not stray from the topic of equal rights.

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[1] *Cornell Critical Thinking Test*, Level X. Robert Ennis, Jason Millman, Thomas Tomko, Pacific Grove, California: Midwest Publications, 1985.

[2] *Cornell Critical Thinking Test*, Level Y. Robert Ennis, Jason Millman, Thomas Tomko. Pacific Grove, California: Midwest Publications, 1985.

[3] *Watson-Glaser Critical Thinking Appraisal*. Goodwin Watson and Edward Glaser. Cleveland: The Psychological Corporation, 1980.

[4] The *Ennis-Weir Criticial Thinking Essay Test*. Robert Ennis and Eric Weir. Pacific Grove, California: Midwest Publications, 1985.

C. Yes, because the ERA guarantees equal rights for all men and women.

D. No, because he speaks of equal opportunity at the beginning and excludes women on the basis of physical strength at the end.

Sample Item:

"I don't know what has happened to peace and order these days, what with all the yelling about this and that. Everybody wants a piece of the action. There is more crime than there used to be. It's about time we restored order around here. It's about time we took the law into our own hands."

Is the person who made these comments being consistent?

A. Yes, because everyone agrees that we need more law and order in this country and a lower crime rate.

B. Yes, because we all have rights guaranteed by the Constitution.

C. No, because not everyone has the same rights.

D. No, because the speaker wants peace and order, but also says we should take the law into our own hands.

Sample Item:

Suppose you know that 80 percent of the people of West Germany are in favor of having cruise missiles in West Germany and that 99 percent of the people at a meeting in Munich are West Germans. Suppose you also know that Hans Planck is at this meeting.

Which of the following would be TRUE?

A. Hans Planck is in favor of having cruise missiles in West Germany.

B. Hans Planck is probably against having cruise missiles in West Germany.

C. Hans Planck might or might not be in favor of having cruise missiles in West Germany.

D. Hans Planck is definitely against having cruise missiles in West Germany.

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4. The School-Designed Test (essay response)

When a school district ventures into designing a thinking skills program, it may need to face the question: Do we also venture into designing our own evaluation plan to measure our specific objectives?

A district that can devote the time and expense to design its own evaluation has created a valuable assessment tool. To date, few districts have accomplished this task.

One district that has designed its own evaluation of its critical thinking program is the Pittsburgh public school district (see case study, Chapter 8). Pittsburgh has developed an essay type of evaluation for its purposes. Pamela Moss and Anthony Petrosky state why they chose an essay format instead of a multiple-choice or short-answer format. "Multiple-choice and short-answer items provide almost no insight into the process that generated the student's response and consequently are not particularly useful for diagnostic purposes." Moss and Petrosky maintain that multiple-choice and short-answer items imply that one best answer is correct. "This implication is antithetical to our goals in teaching critical thinking. The point is not whether students can recognize or produce an answer that the teacher or some other authority considers correct, but rather whether students can adequately explain, validate, and defend responses they have generated."

5. Standardized Basic Skill and Achievement Tests (multiple-choice response)

These tests can provide insight into student capacity to use certain skills that are associated with thinking. Reading tests contain items which measure the student's ability to determine main ideas and draw conclusions from a reading passage. Items on mathematics tests relate to problem solving and reasoning. Science achievement tests may measure the student's ability to classify, interpret information, predict outcomes, analyze, and hypothesize.

Achievement test data can be used to gain some insight into student capacity to apply certain basic thinking skills to a particular content area. However, test items are not specifically designed to measure thinking skills. Therefore, it is important not to overuse the results.

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[5] The *Test of Logical Thinking*, by K. Tabin and W. Capie, Athens, Georgia: University of Georgia.

[6] The *Group Test of Logical Thinking*, by V. Roadrangka, R. Yeany, M. Podilla, Athens, Georgia: University of Georgia.

6. Observation and Diagnosis

When many educators consider a scheme of evaluating a program, they look to standardized tests, competency tests, criterion-reference tests, or a formalized instrument developed in-house. Yet, it is the teacher who works with the students daily and who is paid to assess student progress.

Formalized testing can supply crucial data about student strengths and weaknesses. However, daily observations can provide a system of evaluation that can help teachers determine if expected progress is occurring. The Valley Education Consortium of Oregon recommends that teachers observe students involved in thinking skills and ask them to explain why they are approaching their learning tasks in a particular way. The consortium also recommends that teachers examine student written work to gain insights into the student's thinking process.

One problem area related to teacher observation is expressed by S. Lee Winocur, director of Project IMPACT for Orange County, California: "Teachers need to know what to look for. They may not have a clear picture of what behaviors indicate thinking," states Winocur. Teachers must gain this awareness before they can be effective diagnosticians. And administrators must help the teacher at this point.

The views of Deborah Meier, principal, Central Park School, New York City, are worth noting here. She expounds "the common sense" approach to evaluation. Meier's major points:

> . . . Evaluation of student thinking skills should take place everyday in the classroom. . . . The teacher is the best evaluator of those skills. . . . To function as an evaluator, the teacher must have freedom to think and to act as a thoughtful, reflective person about everything that is going on in the classroom. . . . This means that the administrator must help create and support such a classroom. . . . There is no room in a common-sense approach to evaluation for coaching students to take a multiple-choice test . . . or to encourage them to look for the "right" answer. . . .

The Future of Evaluation

Two kinds of evaluation can be discerned in the future.

The first is teacher-made tests that require students to apply thinking skills. "Teachers need to learn how to design content-area tests which assess how well their students apply critical thinking skills to their content areas," says Barry Beyer, George Mason University.

The Valley Education Consortium (VEC) of Oregon recommends that teachers build test items in order to gain information about student reasoning processes.

To this, William Spooner, North Carolina Department of Education, adds: "We need to help teachers design tests that will help students think and not regurgitate. If you analyze teacher-made tests, 90 percent of the items may require memorization. Teachers cannot be expected to design valid test items without in-depth training. It's got to be a gradual process."

Teachers also will learn to use student writing as a means to evaluate the thinking process. As more school systems begin to use tests, such as the Ennis-Weir Critical Thinking Essay Test or the critical thinking essay test being piloted in California, they will become familiar with techniques for conducting this type of assessment. Ennis and Weir point out in their manual that the teacher must realize that he or she is evaluating student thinking and not student writing.

Essay tests prepared by teachers can be designed to measure student capacity to incorporate logical arguments, value judgments, analogies, observations, or predictions into their writing. Without question, this requires intensive training. It is unrealistic to assume that all teachers will be able to demonstrate the flexibility necessary to evaluate a student's paper without inservice preparation.

The second kind of evaluation to be used widely in the near future is that of "practical" evaluation. In practical evaluation, the student is given a problem-solving task to complete. The teacher, or evaluator, observes the student as he or she completes the task. For example, the student might be asked to create something from a set of materials while under observation by an evaluator.

The National Assessment of Educational Progress (an arm of the Educational Testing Service) has received a one-year grant from the National Science Foundation and the National Institute of Education to study methods of evaluating thinking skill development in 17-year-olds. One area that is receiving attention is the use of simulation. During simulation the student completes one or more action-oriented problem-solving tasks. The study, by the three national agencies, will help to determine if this method of evaluation is beneficial. One point in favor of active simulation exercises is that England has been using them to evaluate student problem-solving skills.

If American educators want to evaluate student thinking ability through simulated activities, then the observer must be highly trained. If classroom teachers are to become the observers, then they must be offered professional training for the tasks.

Ultimate test in thinking: Working out a practical solution

A notable method for assessing student thinking has been designed by the Assessment of Performance Unit (APU) of the Department of Education and Science, London, England. This group has devised a method of observing students during problem-solving tasks. One conclusion: The answer is far less important than the manner by which each student arrives at the answer.

Here is how this assessment works.

Students are presented with a situation that requires them to use problem-solving practices. In one situation students are given the following scenario:

> Imagine you are stranded on a mountainside in cold, dry, windy weather. You can choose a jacket made either of cloth or plastic.
>
> This is what you have to find: Which material would keep you warmer?
>
> (Sample taken from *Science in Schools,* Age 13: Report No. 2, Department of Education for Northern Ireland, Welsh Office.)

The student being tested is given some plastic and some cloth from a blanket, and is allowed to use the following articles in solving the problem: a stopwatch, a hair drier, thermometers, and such desk items as paper clips, rubber bands, etc.

A trained observer introduces the student to the problem and records how the student goes about solving it. The assessment focuses on how the student copes with a problem, as opposed to looking for one correct answer. Below are examples of how two students approached it.

Pupil 1

For one pupil the problem was to find out which material got hotter. To solve it she cut out two jacket shapes. She started the clock and subjected each jacket to hot air from the hairdryer for five minutes. She then felt each jacket and decided that the plastic was the warmer material.

Pupil 2

For another pupil the problem was to determine which material generated most heat. He cut out identical-sized pieces of blanket and plastic and wrapped them separately around two thermometers. He fastened the materials with elastic bands and recorded the initial temperature for each one. Three minutes later he read the temperature again. After puzzling over his results he then reached for the hairdryer. He directed hot air on to each material for three minutes and recorded the new temperatures. This time, satisfied with his results, he concluded that the blanket was the warmer material.

(Science in Schools Age 13: Report No. 2, Department of Education for Northern Ireland, Welsh Office, pages 9–10)

This type of assessment provides a new dimension of information. Multiple choice tests *assume* that the student has used thinking skills to analyze a situation. Essay tests provide more insight into how students have arrived at given conclusions or judgments. However, the approach designed by the Assessment of Performance Unit in England asks the student to work out a solution in practice.

The future of the "practical" approach to evaluation looks bright—at least in Great Britain. "In 1986 we propose to supply teachers centres, local education authorities, and teacher training institutions in England, Wales, and Northern Ireland with APU practical testing kits. This will enable all teachers to familiarize themselves with the kits and experiment with new methods of assessing pupil thinking performance," says C. P. Gower of the Department of Education and Science, London.

Assessing Your District Thinking/ Reasoning Skills Program

The checklist below can help you determine if your district program in thinking/ reasoning skills is headed in a positive direction. Determine whether each item is "Already implemented," "Being considered," or "Not being considered," at this time. The chart is divided into sections, covering instructional practices, teacher participation, principal involvement, teacher and administrator cooperation, student awareness, and school board understanding.

Instructional Practices	Already implemented	Being considered	Not being considered
Thinking and reasoning instruction is designed for all students			
Thinking and reasoning instruction begins at the elementary level and continues through all grades			
Thinking and reasoning instruction is based on a clearly-stated philosophy that teachers accept			
Thinking and reasoning instruction is correlated with subject-matter			
Thinking and reasoning instruction is flexible, geared to the interests, abilities, and needs of students			
Thinking and reasoning instruction is evaluated informally and formally			
Teacher participation			
Teachers understand the definition of thinking used in your district			
Teachers understand the goals and objectives of the program			
Teachers participate in professional development experiences that increase competency in thinking and reasoning instruction			

Teachers emphasize well-thought-out answers, as opposed to one "right" answer			
Teachers know how to ask students questions that stimulate thinking			
Teachers encourage students to apply thinking and reasoning skills to daily life			
Teachers have an opportunity to discuss thinking and reasoning lessons with colleagues and experts			
Teachers wait an appropriate amount of time for students to respond			
Teachers allow students to work in teams for solution of problems			

Principal involvement

Principals understand the goals and objectives of the program			
Principals have been trained to evaluate the quality of thinking instruction in classrooms			
Principals take part in professional development activities in thinking and reasoning			
Principals encourage teachers to incorporate thinking in daily instruction			

Teacher/administrator Cooperation

Teachers and administrators take part in planning and evaluating thinking skills instruction			
Teachers and administrators attend workshops and conferences dealing with thinking skills			
Teachers and administrators plan to provide instructional resources for thinking skills programs			
Teachers and administrators visit other school districts to observe successful thinking programs			

Student awareness

Students are informed that thinking skills are part of their learning objectives			

Students are provided with ample opportunities to practice critical and creative thinking skills			
Students are encouraged to share their thinking skills with members of their families			

School board involvement

The school board has gone through the rigorous process of developing policy statements on the district thinking program			
The school board has approved regulations and guidelines on thinking instruction developed by the administration			
The board is aware that the operating budget provides funds for the thinking program			
The school board is provided with facts so that it can allocate funds for inservice education for teachers preparing to offer instruction in thinking skills			
The school board has the facts and the concepts so that it can explain and promote thinking skills instruction in the community			

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